

POPULAR SCIENCE

MONTHLY



PUTTING THE SILK. The story of the parachute, from stunt man to skytrooper. Page 128.



NEW TACTICS IN THE WAR ON FIRE. Fog and foam save millions in military property. Page 100.

TO THE AMERICAN PEOPLE:

Your sons, husbands and brothers who are standing today upon the battlefronts are fighting for more than victory in war. They are fighting for a new world of freedom and peace.

We upon whom has been placed the responsibility of leading the American forces, appeal to you with all possible earnestness to invest in War Bonds to the fullest extent of your capacity

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BUY MORE WAR BONDS! Here's a message for you from the men who lead our forces to victory.



PACKAGE FOR THE JAPS! See the Navy's Ventura patrol bomber in thrilling color. Page 116.

JUNE 25¢

SECRETS OF NORDEN BOMBSIGHT-PG. 70

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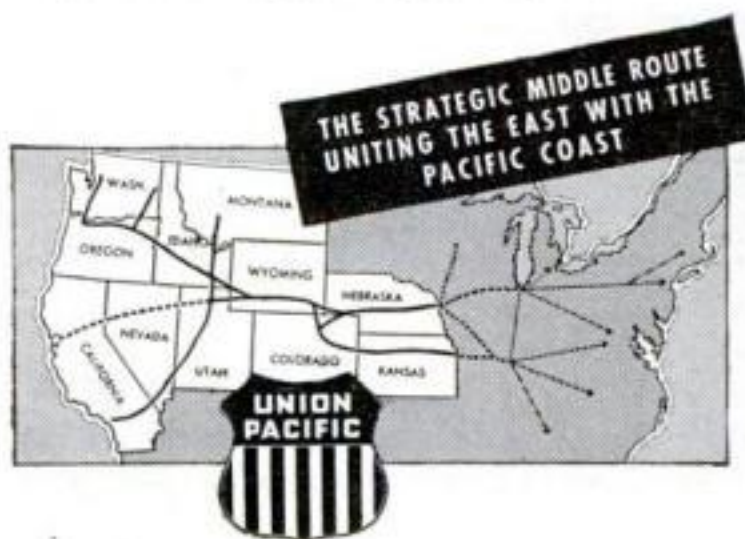
Route, uniting Idaho with the East and the Pacific Coast, it transports the state's products and its citizens.

It is the hope of Idaho home-front workers that America's fighting sons will soon return to re-discover the beauty of the great West... to find that opportunity still exists in the further development of its vast resources... and that hard work and initiative will always be justly rewarded in this land of the free—*your America.*

NOTE: Write Union Pacific, Omaha, Neb., for information regarding industrial or business sites in Idaho or other western states.

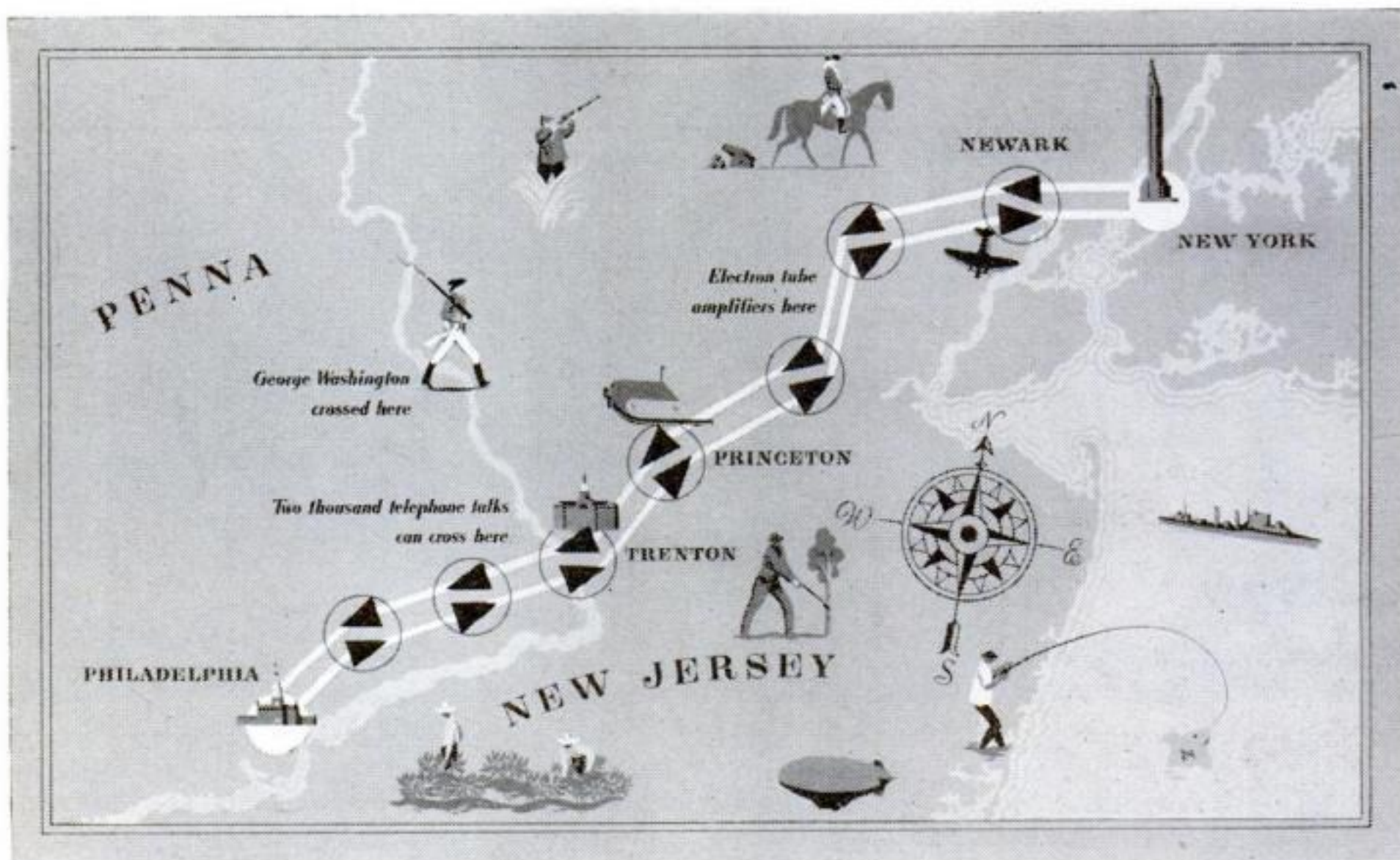
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BETWEEN telephone offices in New York and Philadelphia once stretched a strange sort of laboratory. Most of the way it was underground; engineers made their measurements sometimes in manholes. It was a lead-sheathed cable containing two "coaxials"—each of them a wire supported in the center of a flexible copper tube the size of a lead pencil.

Theory had convinced Bell Laboratory engineers that a coaxial could carry many more telephone talks than a full-sized voice frequency telephone cable; that it could carry adequately a television program. Experimental lengths were tested; terminal apparatus was designed and tried out. Finally, a full-sized trial was made with a

system designed for 480 conversations. It was successful; in one demonstration people talked over a 3800-mile circuit looped back and forth. Now the cable is carrying some of the wartime flood of telephone calls between the two cities.

This cable made television history also: through it in 1940 were brought spot news pictures of a political convention in Philadelphia to be broadcast from New York. Bell System contributions to television, which began with transmission from Washington to New York in 1927, have been laid aside for war work. When peace returns, a notable expansion of coaxial circuits is planned for both telephone and television in our Bell System work.

BELL TELEPHONE LABORATORIES Exploring and inventing, devising and perfecting for our Armed Forces at war and for continued improvements and economies in telephone service.





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MONTHLY

VOL. 146 NO. 6

Mechanics & Handicraft

A TECHNICAL JOURNAL OF SCIENCE AND INDUSTRY

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SUICIDE ATTACK. Ablaze from AA hits, a Jap Frances twin-engined bomber passes close to a U. S. escort carrier after an unsuccessful attempt to crash-dive the ship. On page 65 Allen Raymond, famous war correspondent just back from the Pacific, tells of the fanatical cult of self-destruction on which Japan now pins her dwindling hopes.

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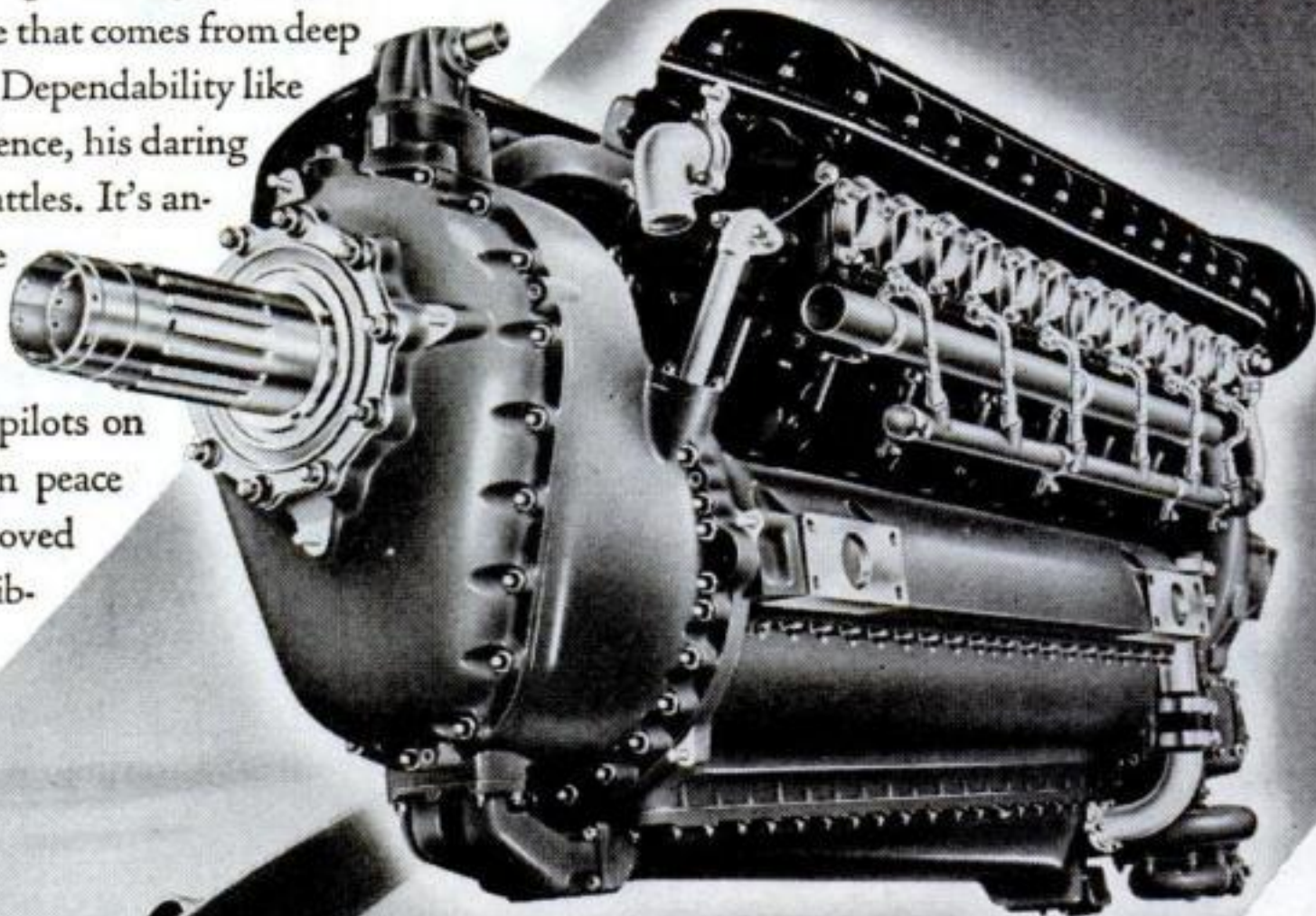
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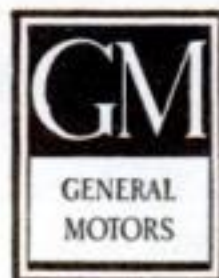
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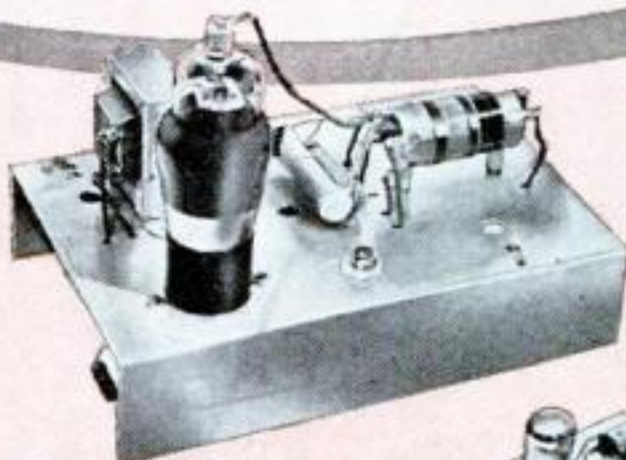
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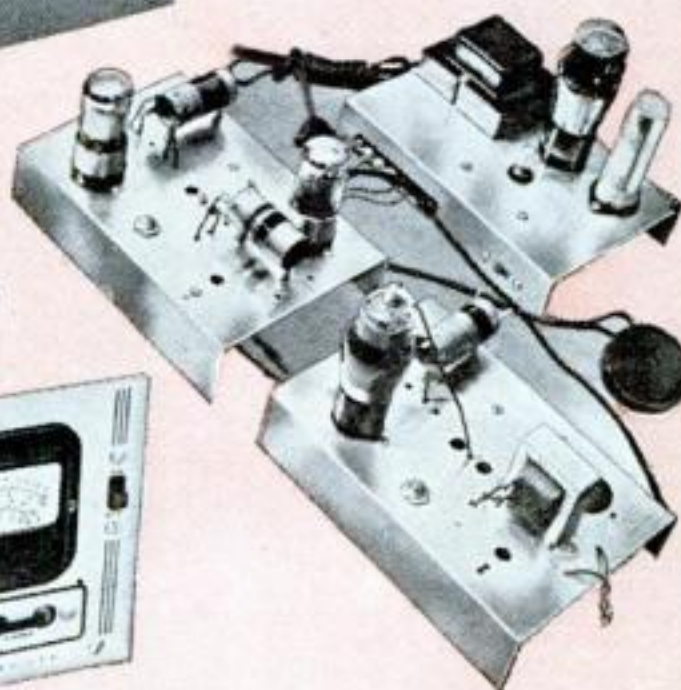
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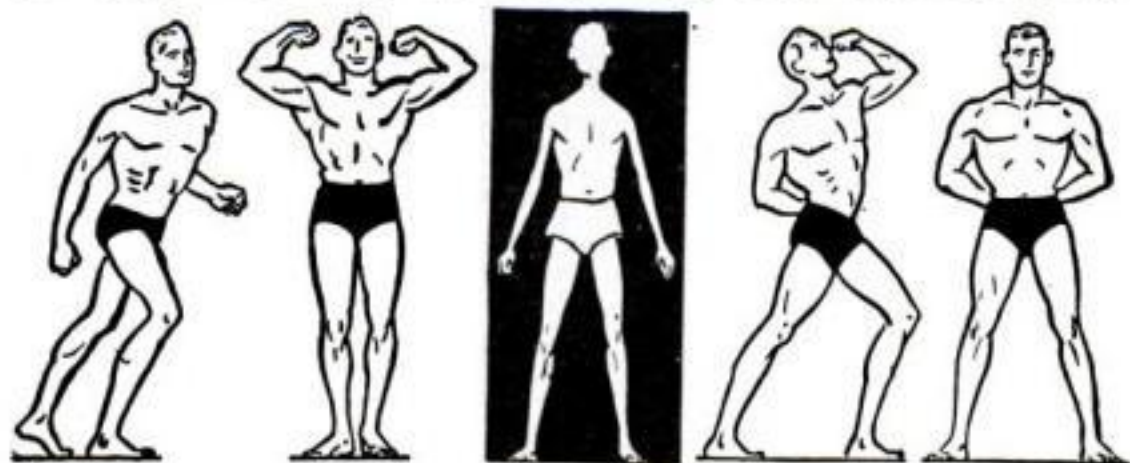
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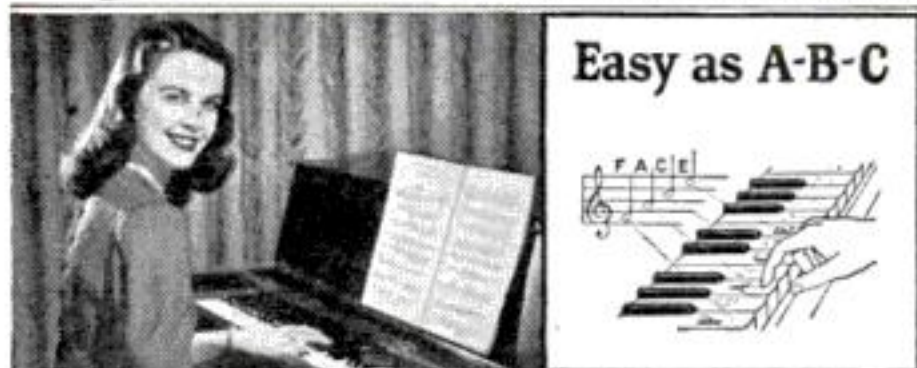
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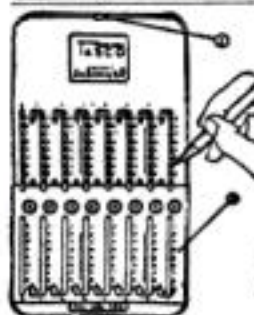
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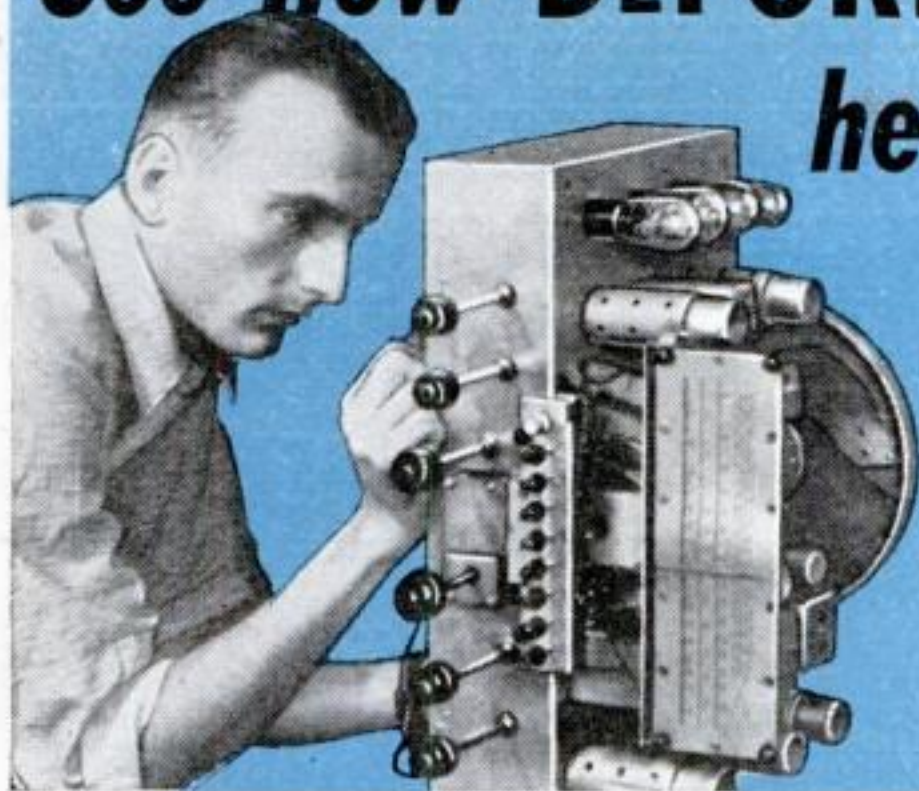
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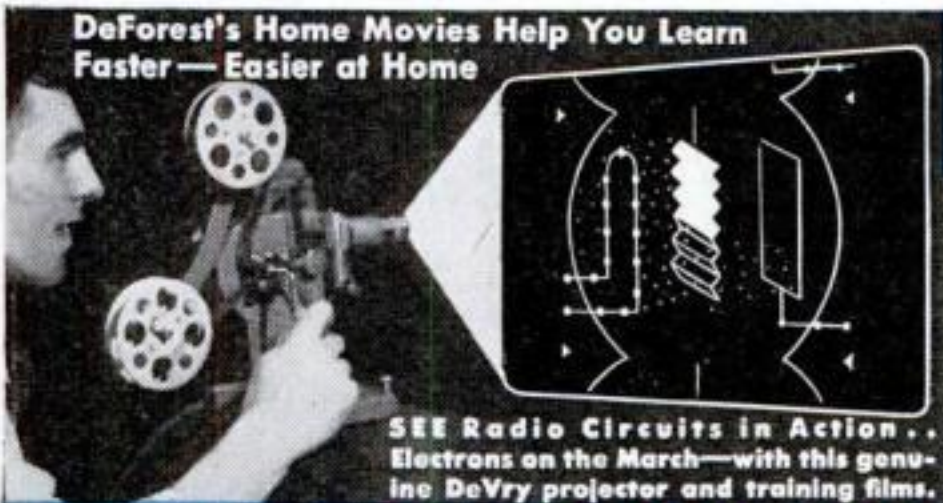
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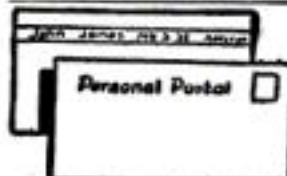


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Readers Say:

Death Rays May Be Weapon for Termite Conquest

IT HAS been found that certain rays of about the frequency of those from neon light will kill bacteria. It has occurred to me that probably stronger rays might kill the termites that work so much damage in wooden houses. I also thought that it would be interesting if the matter could be discussed in P.S.M.; then possibly an experimenter would be able to find some way to kill termites at work through several inches of wood. These insects cause millions of dollars of damage each year.—J. H. T., Palo Alto, Calif.



Red Light on Buttons for Pea-Jacket

I MUST extend my thanks to P.S.M. for forwarding so many jacket buttons, and to those who responded to my request, even though some of the buttons had to be returned. Incidentally, all the buttons were the right kind.—R. A., South River, N. J.

When we printed R. A.'s appeal for a button to replace the one he lost off his Navy pea-jacket, we thought it might bring one in. It did. Then they began to arrive by the dozen. We forwarded R. A. enough buttons to last a lifetime. Please don't send him any more.—Ed.

He Found His Handiwork on a Nazi Prisoner

PVT. MORRIS DIAMOND, before his induction the chief packer of binoculars for this company, wrote us from Germany that he had captured a Nazi soldier. While disarming

him, Diamond's eyes popped, for hanging from the German's neck was a pair of 6 x 30 binoculars that looked very familiar. Sure enough, it was a pair that the young man had packed personally before entering the Army. He identified them by the serial number and the trade-mark on the cover.—M. M. S., Universal Camera Corp., New York City.

Army Man Asks Whether There's a Robot Indexer

I SAY, do compilers of dictionaries, telephone books, and other such lists of words or names use a machine to arrange the items in perfect alphabetical order? If so, what is the machine called, and for heaven's sake how does such a marvel work?—Pfc. A. V., New York City.

We doubt the existence of such a machine. International Business Machines, we're told, has nothing of the sort. The usual procedure is to list each name or subject on a separate card in strictly alphabetical order. Thus any additions that may be necessary can be inserted up to the time the entire list is sent to the printer, who sets it up directly from the individual cards.—Ed.

Satisfied Customer Clarifies the Mapping Question

CONGRATULATIONS on at least 27 years of excellent work in publishing the best home-craft magazine on the market. You have scooped all your rivals as long as I have read your magazine. Answering A. B. N., Syracuse, N. Y., about coastal-line marks, I will say that depending on the size of the maps required to show the particular situation, a scale is chosen; that is, feet per inch or miles per inch. A grid system is set up to suit the country involved, and the coast line accurately surveyed to record the mean line of mean sea level. The map maker then plots the points of the line as closely as possible according to the scale of the map he is making. Most map makers plot the main peninsulas and bays and join the intervening spaces with a curved line if no importance is to be attached to the coast line. Maybe this will be confusing to A. B. N. I suggest that he should find some of those numbered-dot pictures for children and observe how close the dots are together to show the necessary details. He will find that the more dots there are, the smoother the line and the better the picture.—L. L. A., Tacoma, Wash.





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Readers Say:

Fortunes Have Been Made On Worse Ideas Than This

THAT pocket ash receiver that you published an issue or two ago on your inventors' page gave me an even better idea. Why go to the trouble of dolling up a tin can for your ashes, butts, and burned matches? Line one of your pants pockets, preferably a back one, with asbestos, and attach a zipper. But look out when you sit down.—A. R. B., Philadelphia, Pa.



Hydrogen Plus Petrol Ought To Make a Rich Mixture

IN MY study of chemistry, I found that during the use of an automobile battery, hydrogen is discharged. Another fellow and I were thinking of piping the hydrogen from the battery to the carburetor and there having it mix with the air-and-gas mixture. Since hydrogen explodes, it would aid in saving gas, which at the moment is important. My friend tried this on his car, and claims that it increased his mileage about two miles to the gallon. I'm not sure that his records are very exact, and therefore I am writing to get your opinion on the matter. Is it possible that this really worked, or was it a slip on his part in figuring his gas?—R. E. S., Beaverton, Ore.

Home Workshopper Hands Us a Smart Suggestion

IN scanning a recent P.S.M., I saw R. E.'s suggestion on page 172 to use Prussian blue for a depth gauge on a drill. Why not use a small piece of friction tape? It is much easier to apply and remove.—D. A. H., Brattleboro, Vt.

Right enough, D. A. H. Tape will serve if care is taken not to drill beyond the desired depth, but if this is done, the tape will be pushed upward and the depth indication lost. While the Prussian blue may be rubbed off the cutting edge, it will remain in the flutes of the drill.—Ed.

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Readers Say:

Give a Thought to Chestnuts While Developing the Oaks

As a nurseryman always looking for something better, I think developing the acorn, as T. M. of New York is trying to do, is a good idea. But I believe breeding better chestnuts is preferable because the nuts are much superior to acorns in food value and palatability, satisfying both man and beast alike. In addition, chestnut trees grow a little faster than most oaks and will attain larger sizes. Some are known to be over 500 years old and still bearing good crops. Chestnut wood is also superior to oak for certain purposes.

Naturally, we want varieties immune to blight. French growers have had to search for roots resistant to a certain fungus that was also killing trees, and many species of oak have been used successfully as stock. However, the grafting operation is not for beginners, and the slower growth of the root generally retards the growth of the scions. Should a breeders' association be formed, I suggest that both species should be worked on.—A. L., Newcastle, Calif.

This Will Echo Through the Ages As The Smith Idea

SPURRED by the example of the fellow who suggested the revolving-door generator, I am writing another "why-not" letter. The idea is not patented, but if anything comes of it, I want it to be known as The Smith Idea.

In a fairly recent issue of POPULAR SCIENCE MONTHLY I read that the electron microscope can enlarge 100,000 times. (Fancy turning one of those on your mother-in-law!) Now comes the really pertinent part of my letter. Why not build an electron telescope? With such a powerful instrument, we could, for instance, get positively chummy with the people on Mars. We could read the Martian Daily News over their shoulders,

study their agricultural and engineering methods, watch their baseball games, and even give the once-over to their bathing beauties. With an X-ray attachment on the electron telescope, our research might be made even more interesting.—C. E. S., New Orleans, La.





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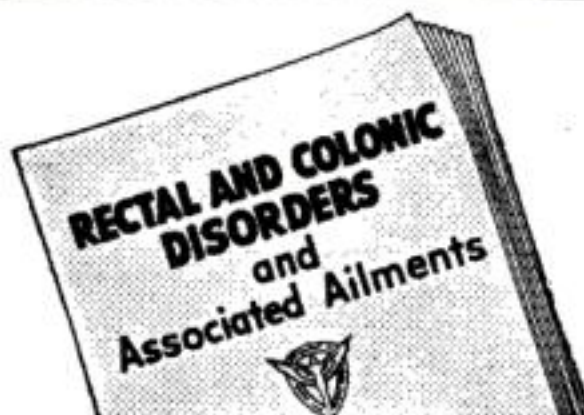


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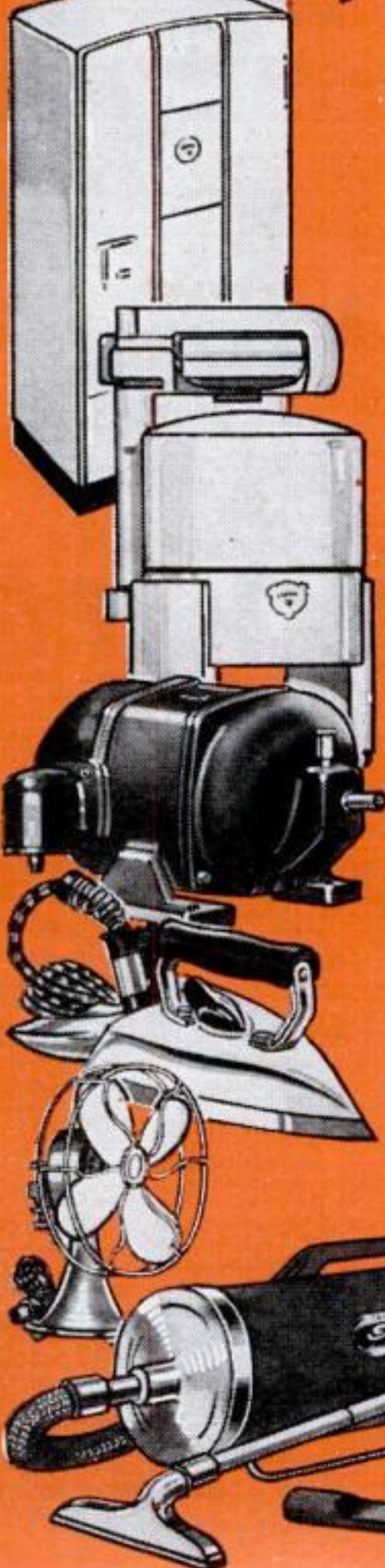
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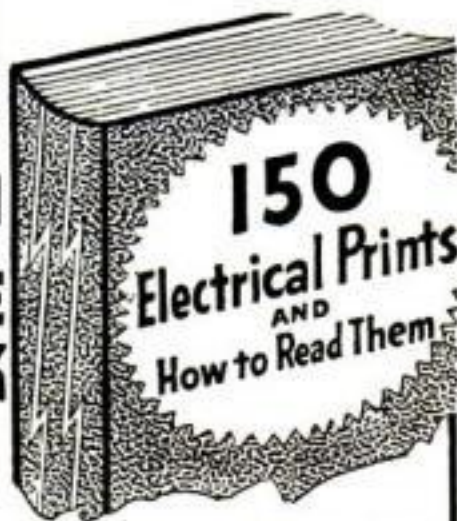
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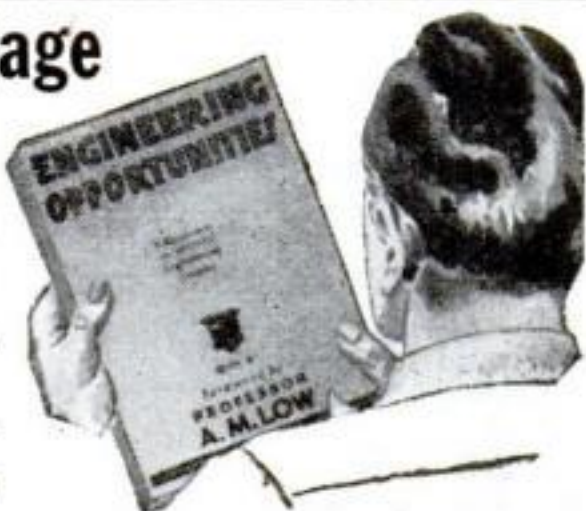
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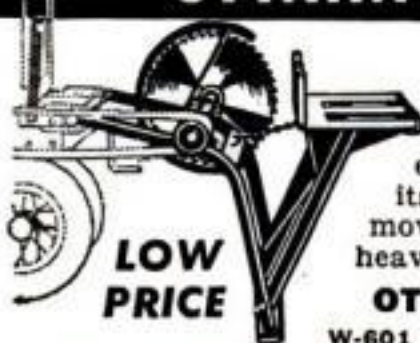
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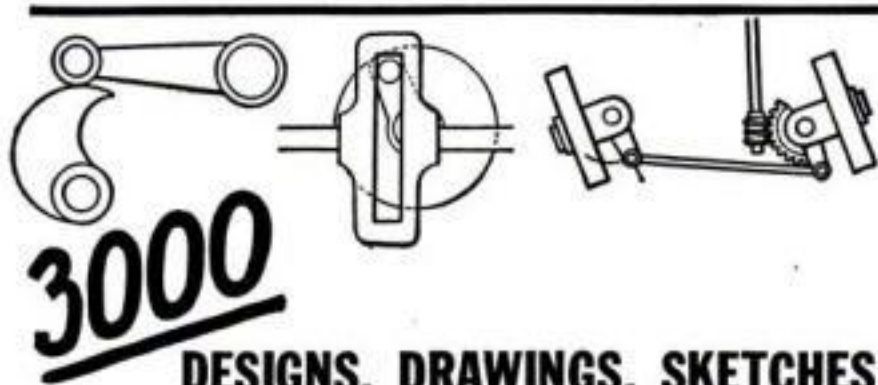


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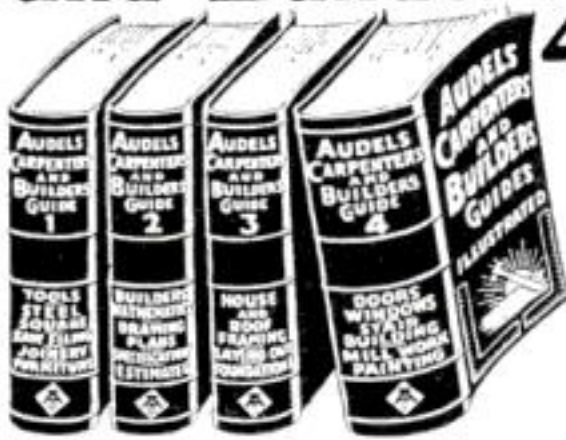
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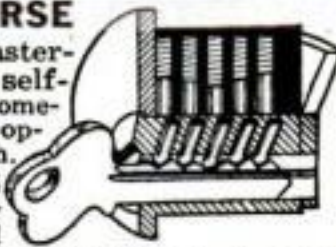
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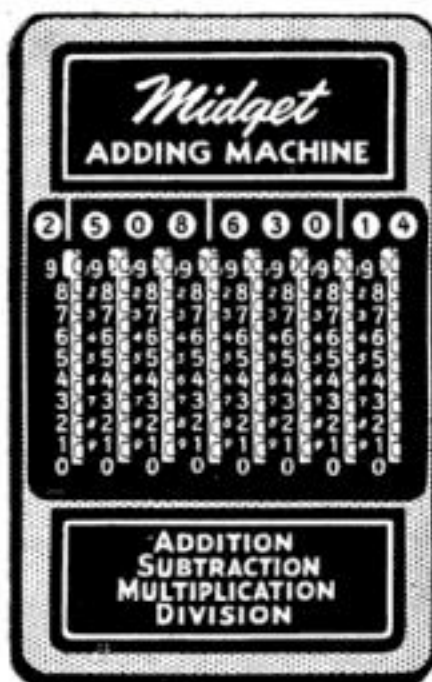
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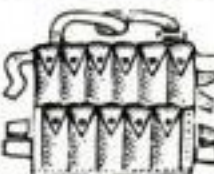
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Genuine wishbone type cavalry spurs. Nicked brass.
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In sheet form. Good workable sizes. Transparent. For costume jewelry, etc. Easy to work and polish. **B280-5 LB. ASST. \$4.75**
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Values galore! Hundreds of hard-to-find items for home, shop and outdoors at tremendous savings.
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Dept. PS6
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Chicago 5, Ill.

Classified Ads only 35c per word per insertion, payable in advance. Minimum ad 10 words. White space \$2.00 per line. To be included in July issue, copy should be in our office by June 1st. July issue on sale July 1st.

Beginning with the September 1945 issue prices will be increased to 50c per word per insertion, payable in advance. Minimum ad 10 words. White space 3.00 per line.

POPULAR SCIENCE MONTHLY—351 FOURTH AVE.—NEW YORK CITY 10

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MYTEE-BOND Miracle Adhesive. Tried once you'll never be without it. Send 35c. Slomons, Long Island City.

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ADVERTISING Placed everywhere lowest rates. Reliable guidance on publications, expert assistance on ads without charge. Newspaper, magazine, mailing-list rate-book free. Chicago Advertising Agency, 20-MP West Jackson, Chicago 4.

SALES—Letters by former Assistant Director of Correspondence at Sears, Roebuck & Co. Write fully. Director, 1832 Stanwood Street, Philadelphia 15, Pa.

PRINTERS, artists, draftsmen, anyone, make your own engravings at home. \$5.45 (Simple). Carson Institute, Plainview at Schoolcraft, 23, Detroit.

ADVERTISE: 24 words, 149 newspapers, \$6.50. Lists Free. Advertising Bureau, 4515-P Cottage Grove, Chicago 15.

ADVERTISING That Sells. Revealing folder, dime, Dorris, 157½ W. Colorado, Sheridan, Wyoming.

INCH Display advertisement fifty magazines, year \$24. Wood's Popular Services, Atlantic City, N. J.

50 WORDS 10,000 readers 3 months \$3.00. Renick, Holland, New York.

20 WORDS 30 newspapers \$2.00. Goodale, 37 Gardner, Vallejo, California.

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DRUNKENNESS Is a disease which responds to treatment. Medical skill plus human sympathy prove successful with liquor and drug cases. 60 years experience. Write for free booklet. P. S. Nelson, The Keeley Institute, Dwight, Ill.

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PAN-AMERICAN Academy of Aeronautics, 2300 W. Flagler, Miami 35, Florida. Teach Aircraft Drafting, Engines, Instruments, Radio Navigation better, cheaper. Approved Pre-Induction and Industrial Training Center for Men, Women. Florida's Finest Institution.

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SILVER Plating and Polishing Liquid. Apply with a cloth. A rub-on process, not a dipping method. Cleans, silverplates, polishes, one rubbing. Works wonders on silverware, musical instruments, antiques, brass, copper, bronze, zinc, nickel-silver and german-silver metals, and some others. Over 100 other uses. Distributors wanted to sell to jobbers, retail dealers, agents, salesmen, etc. Details free. NuSilver, Dept. 167, Aurora, Illinois.

AMAZING year round greeting card cash getter. Sell foremost \$1.00 All Occasion assortment to friends, fellow workers, Church organizations. Latest vogue designs. Unsurpassed value. Costs you 50c up. 9 fast selling boxes. Up to 100% profit. Experience unnecessary. Special offer. Request sample assortment on approval, extra money plan. Bluebird Studios, Dept. 17C, Fitchburg, Mass.

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MAGIC Races. At touch of lighted cigarette, six horses are off! Watch them Run! 55 Races in mailing carton, \$1.00. Agents Commission, 40%, in dozen lots. Order direct from this ad, or send 10c for sample envelope (5 races) and complete details. Pines, Box 32, Flushing 35, New York.

FREE Water and our concentrates makes flavors, lotions, shampoos. 72 products, labels, bottles furnished. Qualco, F-20030 Russell, Detroit.

GOOD Paying Business Silvering mirrors, plating autoparts, reflectors, bicycles, bathroom fixtures, etc., by late method. No tanks or shop required, outfit furnished. Free Booklet. Gunmetal Co., Ave. G, Decatur, Illinois.

LOOK Here! Wanted—Men and Women to start in business on our capital. Sell some 200 farm-home Products. Thousands our Dealer's now make quick sales, big profits. For particulars write Rawleigh Co., Department F-192-PSC, Freeport, Illinois.

MAKE money in your spare time! Helps furnished. Easy sales. Voluntary repeat orders. Liberal commissions. Send for Free Wholesale Price List Today! Write McGregor Magazine Agency, Dept. PS 5, Mount Morris, Illinois.

LUMINOUS pictures that glow in the dark. Large manufacturer wants factory representatives; wonderful new item; fast seller; free sample. Madison Mills, 303 Fourth Ave., N.Y.C.

CIGARETTES Galore! World's Best Machine, guaranteed, makes factory style, retails for 89c, cost 39c in quantities. Sample dozen \$6.00 postpaid. Catalog with order. Diverso, 610 Water, Milwaukee, Wis.

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MAGIC Races—At cigarette touch six horses are off. Fast seller. Big profits. 40 Races \$1.00. Dime brings samples, wholesale prices. Barkley Co., Dryden 5, Virginia.

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WHOLESALE: Razor Blades, Laces, Excello, Texide, Silvertex and others. Write for prices and information. National Sales Company, Dept. 114, 1319 Stone Street, Flint 4, Mich.

BIG profits taking subscriptions for all magazines. Agents' Confidential Catalog listing over 2500 periodicals and complete starting supplies Free. Pines Subscription Agency, Flushing, New York.

AGENTS. Everyone wants beautiful 12 by 16 Honor Scrolls of loved ones. Retail \$1.00. Sample at wholesale 40c prepaid. Particulars, Condon, Box 157, Upper Darby, Pa.

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\$3 FIRE Extinguisher sells wholesale or direct. Fire-Killer, 97 Franklin, Syracuse, New York.

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INDIAN relics. Coins, Minerals, glassware. Catalog 5c. Sistershop, Northbranch, Kansas.

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SEE Our advertisements under Motorcycles Classification. Clymer, 2125 W. Pico, Los Angeles 6, Calif.

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1945 IGNITION Supercharger \$3.50 fast starting, mileage, pep. EG Mfg. Co., 355B E. 149 St., N. Y. 55.

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NOW! Water injection for your car! Closest approach yet to the actual installation on fighter planes, and we are making it possible for you to share the spectacular benefits, any make or model. Increase power and mileage up to 30%. Decrease carbon and engine wear. Developed and proven under engineering supervision. Anybody can make installation at Very Low Cost and with minimum tools. All parts available to civilians. Wonderful opportunity postwar and Now! Complete plans and instructions, only \$2.00 cash, check, or money order. Hughes Engineering Laboratory, 1020 Jefferson, Evansville 14, Indiana.

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AMAZING new Moto-Vator injects water-vapor into motor just like newest fighter planes. Burns 15% water; saves 20% to 30% gas; Prevents Carbon; Increases power! Eliminates carbon and valve jobs. Not a gadget. Sensational performance keeps motor like new. Wonderful postwar possibilities. No investment. . . . One low price includes license to install Moto-Vator in your locality. Send 10c for booklet giving complete details. Dept. S, SX Laboratories, P.O. Box 37, Middle Village, Long Island, New York.

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CONVERT your auto, tractor or marine engine to burn diesel or stove oil. Proven factory method. Different and better. Costs nothing to investigate. Write for free circular No. 3. Harrington Co. 222-224 S. W. Stark St., Portland 4, Oregon.

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WE carry Moto-Scoot parts for Lauson and Briggs-Stratton motors. Write for folder on new Amco Centrifugal clutch. American Moto-Scoot, 1319 W. Carroll Ave., Chicago, Ill.

BIG box, 10 lb. box, of over 3,000 popular size assortment of steel bolts, nuts, screws, washers, cotter pins, hose clamps etc. \$5.00 postpaid. Meltz Aircraft, Hardware Dept., New Brunswick, N. J.

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HAVING Car Trouble? New, Used, guaranteed auto, truck parts save money. Transmission specialists. Describe needs; immediate reply. Victory, 2439-14 Gunnison, Chicago 25.

START your car easy with new wonder gadget. Money back in 5 days if not amazed. Send \$2.00, Car Model, Year and Make. Sciuto, 4955 Magnolia, St. Louis 9, Mo.

DUAL Mufflers, Ford V-8, Mercury. Pleasing tone, steel packed. Reduces back pressure, increases power. Complete, E-Z install. DeLuxe \$20.00. Give car model. Clymer, 2125 W. Pico, Los Angeles 6, Calif.

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PRESERVE your tires with plastic and puncture-proof your tires. Details for stamp. Betke, Box 699, Borger, Texas.

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BUILD your own Trailer! Save Money! Have every feature you want! Plans for House, Sport, Camp and Utility trailers. Catalog describing 9 models 10c. Jim Dandy, Box 125-B, Wausau, Wisconsin.

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NICHOLAS-Beasley Monoplane \$150, complete; lightplane motors as low as \$45 complete with propeller. Send 25c for Spring War-Bargain catalogue listing hundreds of buys in airplanes, motors, crack-ups, salvage, located everywhere, some probably near you. (35c by first class mail). Used Aircraft Directory, Athens, Ohio.

TAYLORCRAFT \$350, Aeronca \$175, Cub \$500 (Just overhauled). New catalog, over 350 aircraft bargains, 25c. Special section lists used engines, parts, parachutes, etc. National, Box CS-1682, Toledo, Ohio.

BECOME an Aircraft operator or distributor. This and scores of other business opportunities outlined in New Prospectus. 25c. Associated, 2557 Charlestown, Toledo, Ohio.

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JUNE Special. Electric brooder, 100 Heavy breed chicks, (non-sexed) \$17.45. Postage prepaid. Free folder. Amstutz Hatcheries, Box 44, Orville, Ohio.

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STORAGE Batteries Restored! Amazing secret formulas renew wornout batteries. Patents now expired; official copies from Patent Office, 3 different formulas \$1.00, postpaid. You can use and sell too! Crehore, Box 2329Y, Washington 13, D. C.

EDISON Batteries: Power, Light. Five year guarantees. Fifteen year life. Complete lighting equipment. Free literature. See-Jay Company, 321 Yonkers Avenue, Yonkers, New York.

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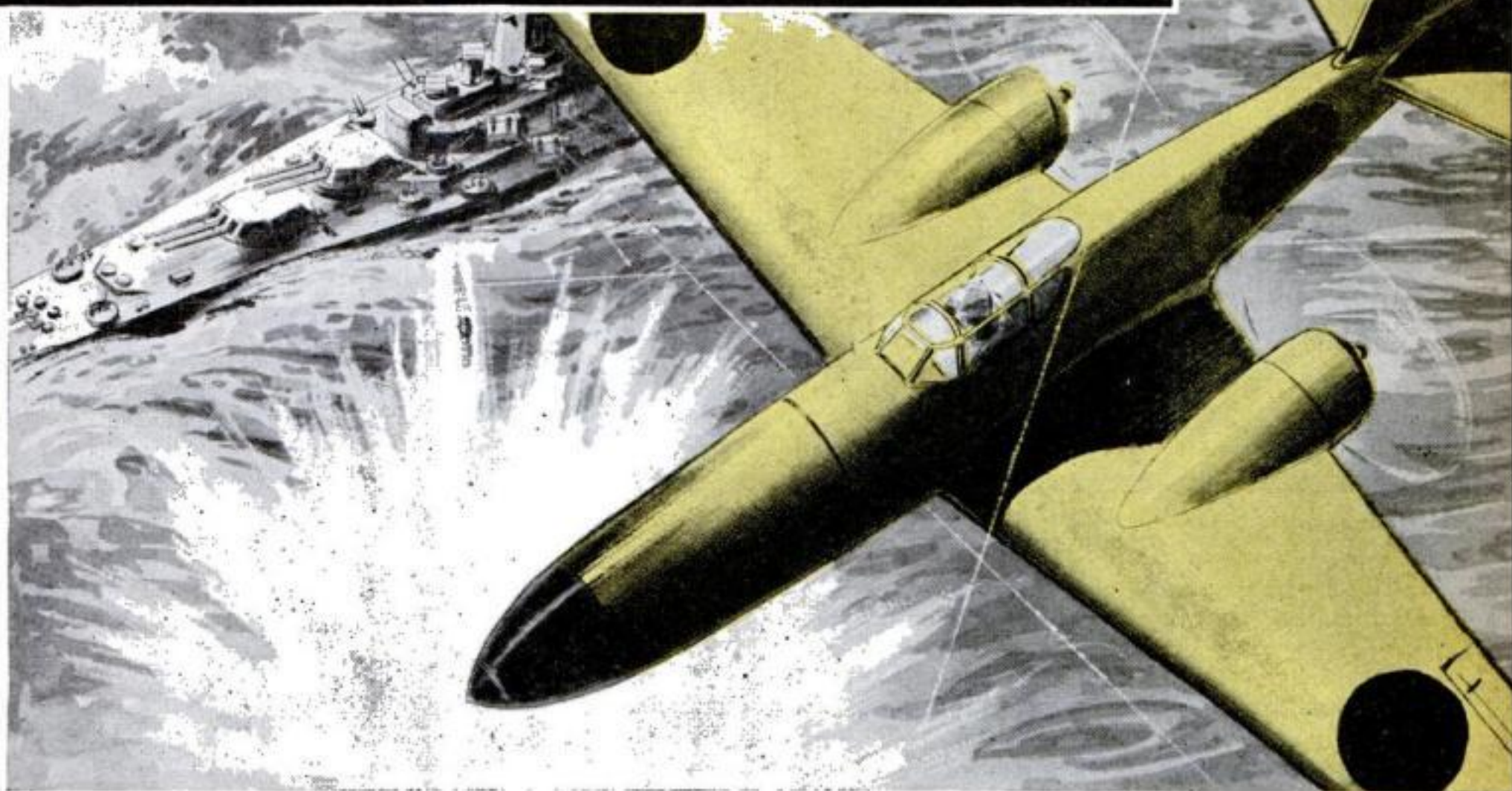
Notice the great improvement in clarity, as well as in speed. Because of RCA research, radiophoto prints are no longer blurred by a "pattern." They're about as clear as the original prints thousands of miles away.

RADIO CORPORATION of AMERICA

PIONEERS IN PROGRESS



the Rising Sun Pins Its Hopes on **JAP SUICIDE KILLERS**



RENDEZVOUS WITH DEATH is the mission assigned to flyers of the Jap Kami-Kaze Corps— young men who have volunteered to die in an effort to destroy the enemies of the Empire.

THEY WANT TO DIE. Self-sacrifice is rooted in Jap psychology. On Leyte, 137,000 Japs were killed, while only 882 of them were taken prisoner.

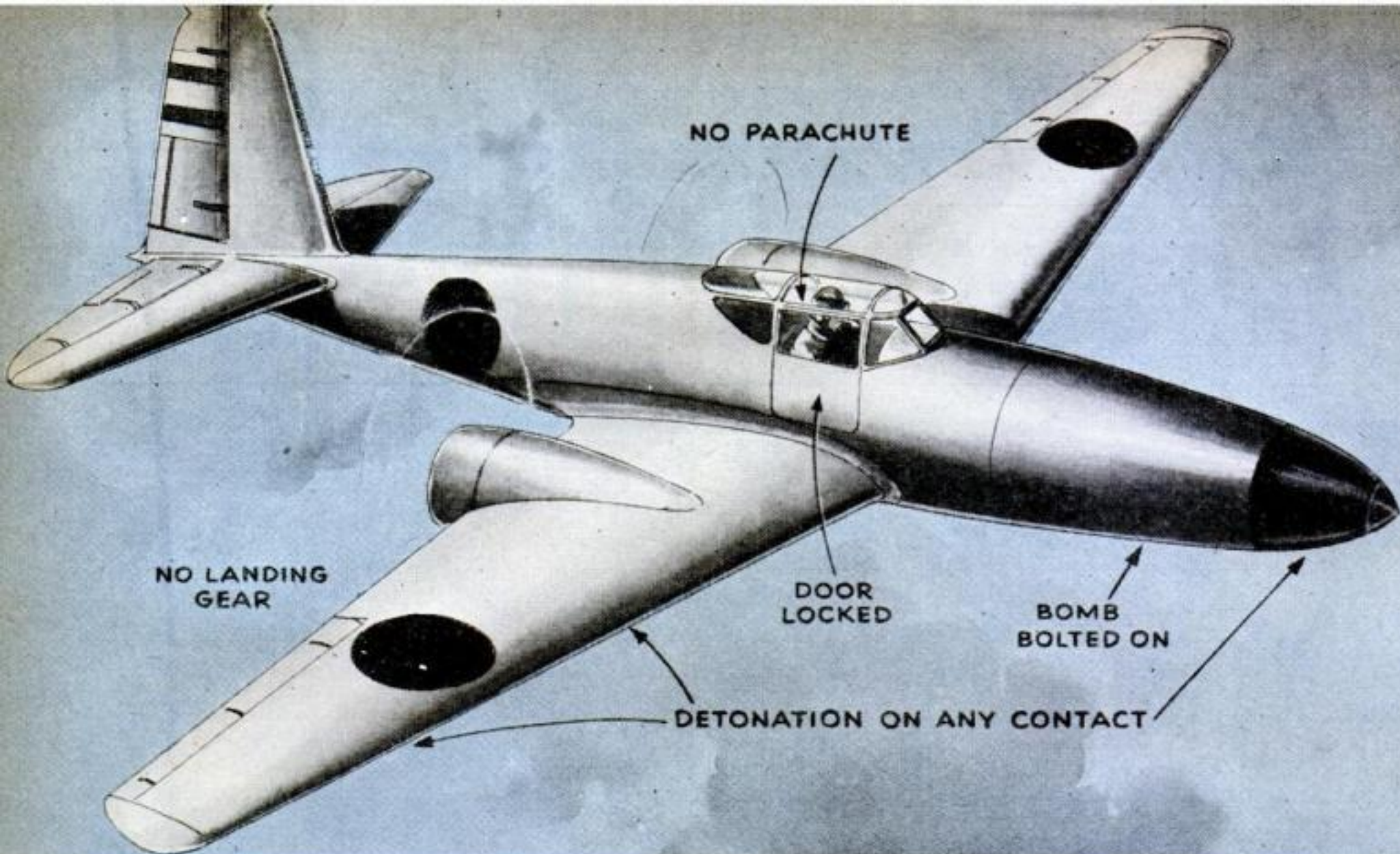
A veteran war correspondent tells how fanatical hatred and weird rites send pilots of Kami-Kaze Corps to death.

By ALLEN RAYMOND

OUT of the depths of savagery and superstition the Japanese have forged a fantastic weapon to hurl at their American enemies by land, sea, and air. It is merely an idea—the glorification of death in battle. The high command of the Japanese armed forces has taken this idea and indoctrinated picked groups of young men with it, so that they deliberately go out seeking suicide in attacks on their Empire's foes.

These suicide killers are not looking for victory. They are not trained to do the maximum damage possible to their enemies. Apparently they are anxious merely to die while attacking Americans, in a spectacular gesture of Japanese superiority. Picked





THERE'S NO ESCAPE for a suicide pilot after he takes off on his fatal mission. To make sure that he won't change his mind, he is locked in his cockpit, with no parachute and no landing gear—and a load of destruction that will go off at a touch. In spite of these elaborate precautions, a few of the fanatical Japanese flyers have lived to be captured and are now in the hands of American forces.

aviators with this idea come diving through flak in an all-out effort to crash their planes with loads of explosives on the decks of our warships. Picked infantrymen lie camouflaged, hugging supplies of dynamite, in the path of our tanks or trucks on islands such as Iwo or Okinawa, hoping to blow themselves up with some American vehicle and a few American men. Jap suicide killers in little motorboats come dashing out of Pacific harbors by night, yearning to end their lives in a big explosion against the hull of an American ship.

It is a strange type of warfare, judged by Occidental standards, but a very natural development in this Oriental people, trained to regard hara-kiri, or ceremonial suicide, as one of the grandest acts of which man is capable.

It was not until Admiral of the Fleet Chester W. Nimitz, early in April, announced that the Japs were using suicide pilots in an attempt to sink our ships that the veil of censorship was ripped from this phase of war in the Pacific, which had been a subject for laughter and amazement among our fighting men there for more than six months. The Admiral denied Japanese claims that their suicide killers had sunk several of our battleships and cruisers and major carriers.

No battleship, cruiser, or Essex-class carrier had yet been sunk by these Nip tactics, he said. Some of the Jap suicide

killers who failed in their objectives have been captured. Now it can be revealed that they were members of a "Kami-Kaze" Corps, which takes its name from the God of the Wind in Japanese mythology.

The Kami-Kaze flyers are pretty young—most of them between 18 and 20. They have been graduated from cadet schools as fighter pilots, and then have volunteered for certain death in battle. They are consecrated men. Once they have taken their vow to die for their Emperor they are as good as dead, and they know it. When they fly on their missions they are locked into their cockpits. The wheels of their planes drop away automatically as they leave the ground. Their explosive loads are so built into the planes that they can't be jettisoned. No Kami-Kaze pilot ever carries a parachute. The instant his plane comes into contact with anything, it goes to pieces in a big explosion and a swiftly spreading flame, carrying the pilot to a glorious immortality and—possibly—destroying some American target.

After their graduation from cadet school, these Kami-Kaze pilots get a six-months special training course, and then a great feast. The feast may last for several days. It includes plenty of sake and the finest foods. The prettiest geisha girls entertain these death-dedicated airmen. The pilots paint their faces white, simulating death's pallor.

According to reports from China, the Kami-Kaze flyers usually shave their heads except for a little round patch of hair on the top of their skulls, and there is a smaller shaven circle within that patch. They dress in ceremonial robes of black. During the final days of their leave, before their fatal mission, they walk through the streets with hands folded across their chests. They never smile. People meeting them bow and get out of their way. When they start their fatal mission, the Kami-Kaze pilots circle the field three times, while all the personnel of the field stand at attention till they are out on their course.

Dispatches from Kunming, China, say that a new suicide plane is going into mass production in Manchuria, which has a long ton of explosive—2,240 pounds—built into its nose like a torpedo war head. The propeller is in the rear. It is nothing more nor less than a flying bomb, guided by a human being, which may prove quite as damaging as Germany's famous V-bombs.

The night before the landing of American forces in Lingayen Gulf on Luzon, I was aboard an American destroyer. A Jap suicide killer in a little motorboat came rushing through the darkness toward the vessel in which I was sleeping. A gunner aboard the destroyer blew up this assailant at 100 yards' range, and the explosion was so severe that it put out the lights in several officers' cabins.

The latest suicide weapon to be unveiled by the Japs is a "rocket bomb"—really a small rocket-propelled airplane with a 16-foot wing span, which is launched from a larger aircraft and guided toward its target by a suicide pilot. These were first used in the defense of Okinawa.

The Japs pin their faith on this sort of tactics, while the American fighting man will try to kill his enemies and live. The ratio of Japanese and American casualties would seem to indicate the superiority of our kind of warfare.

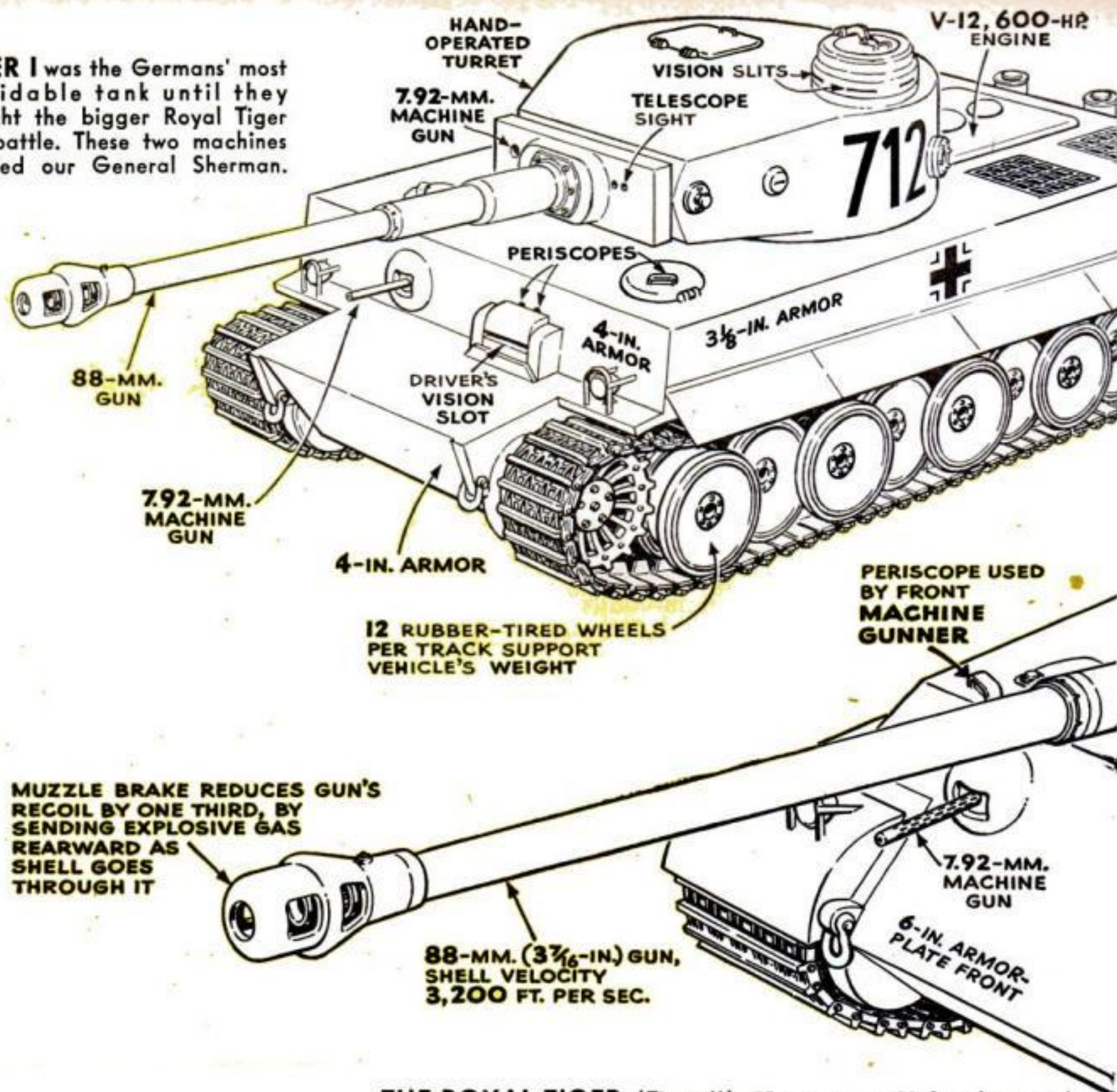


DOOMED MEN, Kami-Kaze pilots spend their last few days walking through the streets with folded hands, dressed in black ceremonial robes. People they meet step aside and bow to them. Before this, at the end of their training, they are given a big feast with sake and geisha girls.

MOTORBOATS are suicide weapons, too. Dashing out of Pacific harbors at night, they drive full tilt at American warships. Torpedoes or explosives are built into their bows, ready to go off on contact with a hull. Our gunners get them.



TIGER I was the Germans' most formidable tank until they brought the bigger Royal Tiger into battle. These two machines dwarfed our General Sherman.



THE ROYAL TIGER (Tiger II), 75 tons, over 23 feet long and almost 12 feet wide, was the biggest on the European battlefield. Its 88-mm. gun bowed only to the 122-mm. of the Stalin tank.

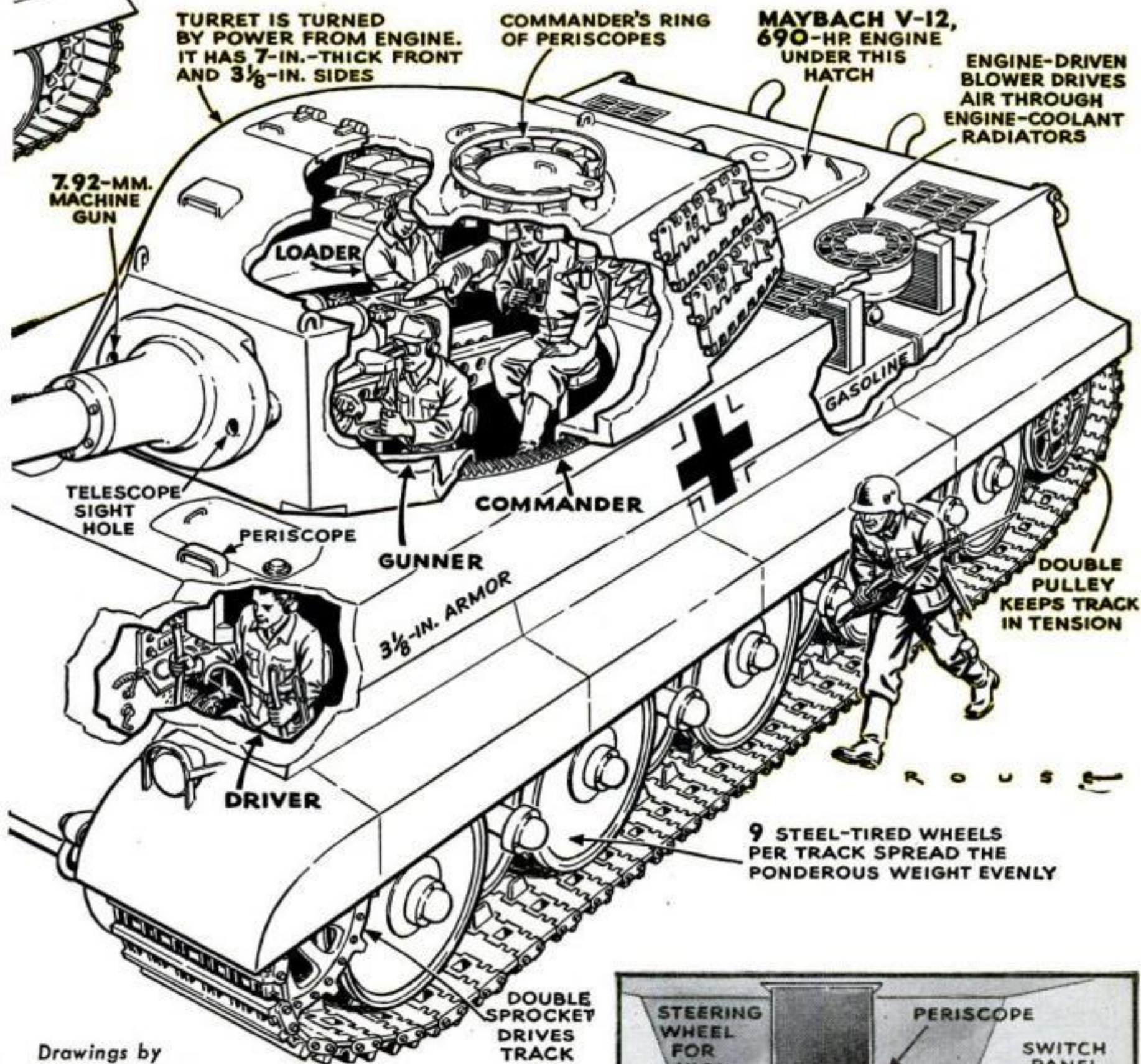
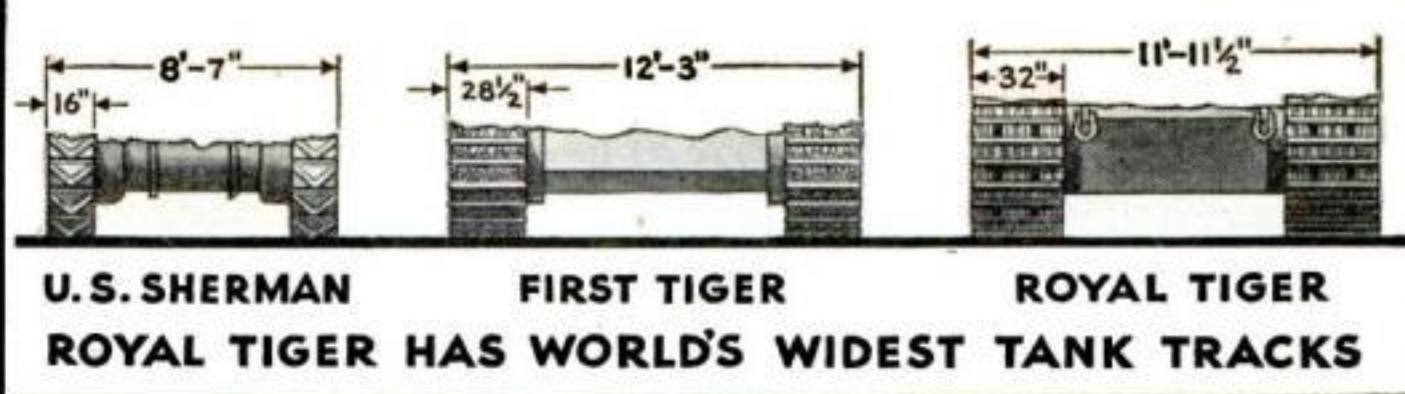
Under the Tiger's Skin

FIVE-MAN CREW OPERATED GERMANY'S 75-TON MONSTER

NOW we can fully understand why GI tank men "griped" about the General Sherman medium tank when they had to pit their weapon against the German Royal Tiger in their sweep through France and western and southern Germany. Stewart Rouse, POPULAR SCIENCE staff artist, visited the Army's Aberdeen Proving Ground in Maryland, where he inspected both the 60-ton Tiger and the 75-ton Royal Tiger, brought over here for study by American tank experts. His drawings emphasize the massiveness of these steel monsters, and high-light the salient qualities of the slug-ging heavyweights.

The Royal Tiger—not a big brother to

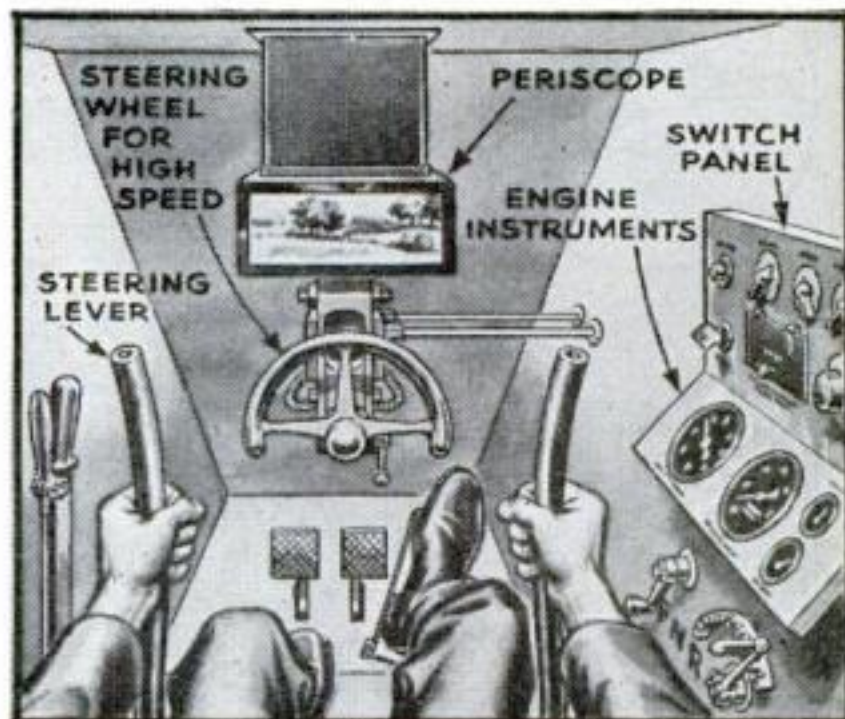
the Tiger, but more an enlargement of the Wehrmacht's 45-ton Panther—is equipped with 32-inch tracks, the widest tank tracks in the world, which gave it better flotation over the muddy terrain of the battlefield. Its firepower consists of one 88-mm. gun with a shell velocity of 3,200 feet per second and two 7.92-mm. machine guns. Powered by a 690-horsepower engine and manned by a crew of five, the Royal could thunder over the countryside at a top speed of 24 miles an hour. It is protected by frontal armor from six to 12 inches thick and 3 1/8-inch armor on the sides. Its power-turned turret has seven-inch-thick armor in the front and 3 1/8-inch armor on the sides.



Drawings by
STEWART ROUSE

Water barriers up to six feet deep were mere puddles to the nine-foot, six-inch Royal Tiger, its watertight body permitting it to run on the bottom of a stream without stalling. Also, its more than 23-foot length allowed it to bridge ditches without toppling in.

But the sheer weight of the Royal Tiger led to its downfall. The Nazis had to sacrifice speed and maneuverability for protection and firepower. The more vulnerable Allied tanks, with their speed, maneuverability, and superiority in mechanical qualities and number, were able to punch and keep punching, piling up the blows that were to knock out their giant opponent.



DRIVER'S view shows the usual clutch, brake, and foot pedals, and emergency brake. Steering levers are for tight turning at low speeds. Crank lever at lower right selects eight forward and four reverse speeds, determined by position of other lever.

The War's Most Closely Guarded Secret Revealed: How the Norden Bombsight

Does Its Job

Here's the heart of precision bombing, which blasted Berlin and is even now razing Tokyo.

By VOLTA TORREY

Drawings by ERIC SLOANE



THE WRAPS ARE OFF! A lucky New York boy gets a look through the Norden bombsight, with one of the designers, Capt. R. I. Entwistle, USN, to explain it to him. The scene is a Navy exhibit at the Museum of Science and Industry, and Louis Marrone, of the Bronx, is the spellbound visitor.

THE Norden bombsight, one of the most fascinating, hush-hush tools used in winning World War II, is both a magician and a mathematician. It creates an illusion, and uses that bit of magic to solve two problems in trigonometry faster than a professor of mathematics could do it.

The illusion is that an airplane racing toward a target with the bombsight is not moving; the problems are *where* and *when* to drop a bomb. When the bombardier has set the sight so that the illusion is perfect, his work is done. Lady Luck can relax, too—because the bomb's destination has then become a mathematical certainty.

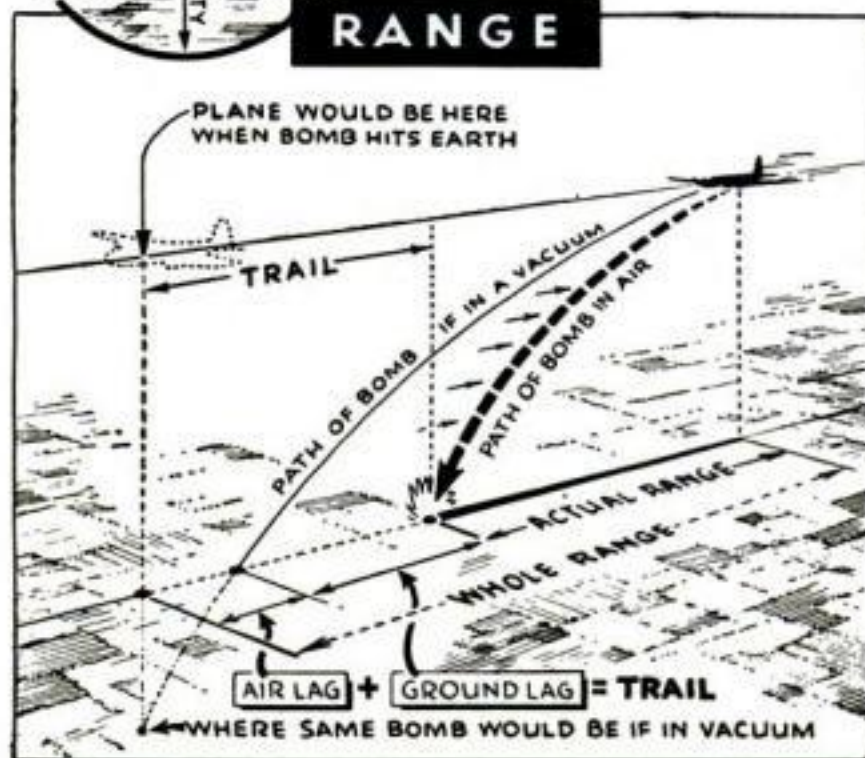
Guided by the illusion, the mechanical wizard orders other robots to fly the plane to the right place and drop a bomb at the

FINDING THE RANGE AND COURSE ARE THE SIGHT'S TWO PROBLEMS

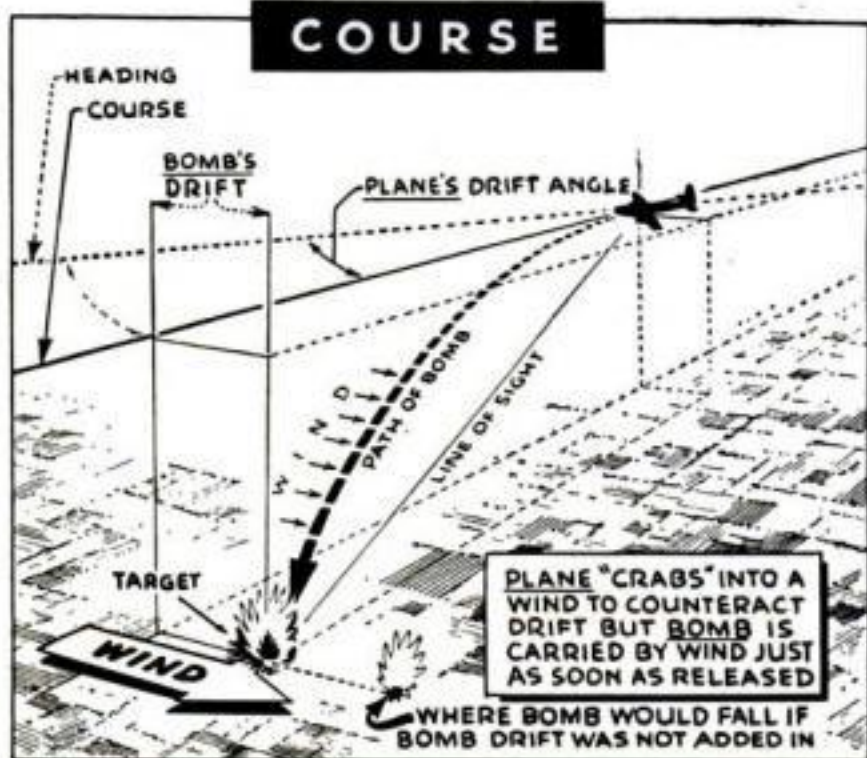


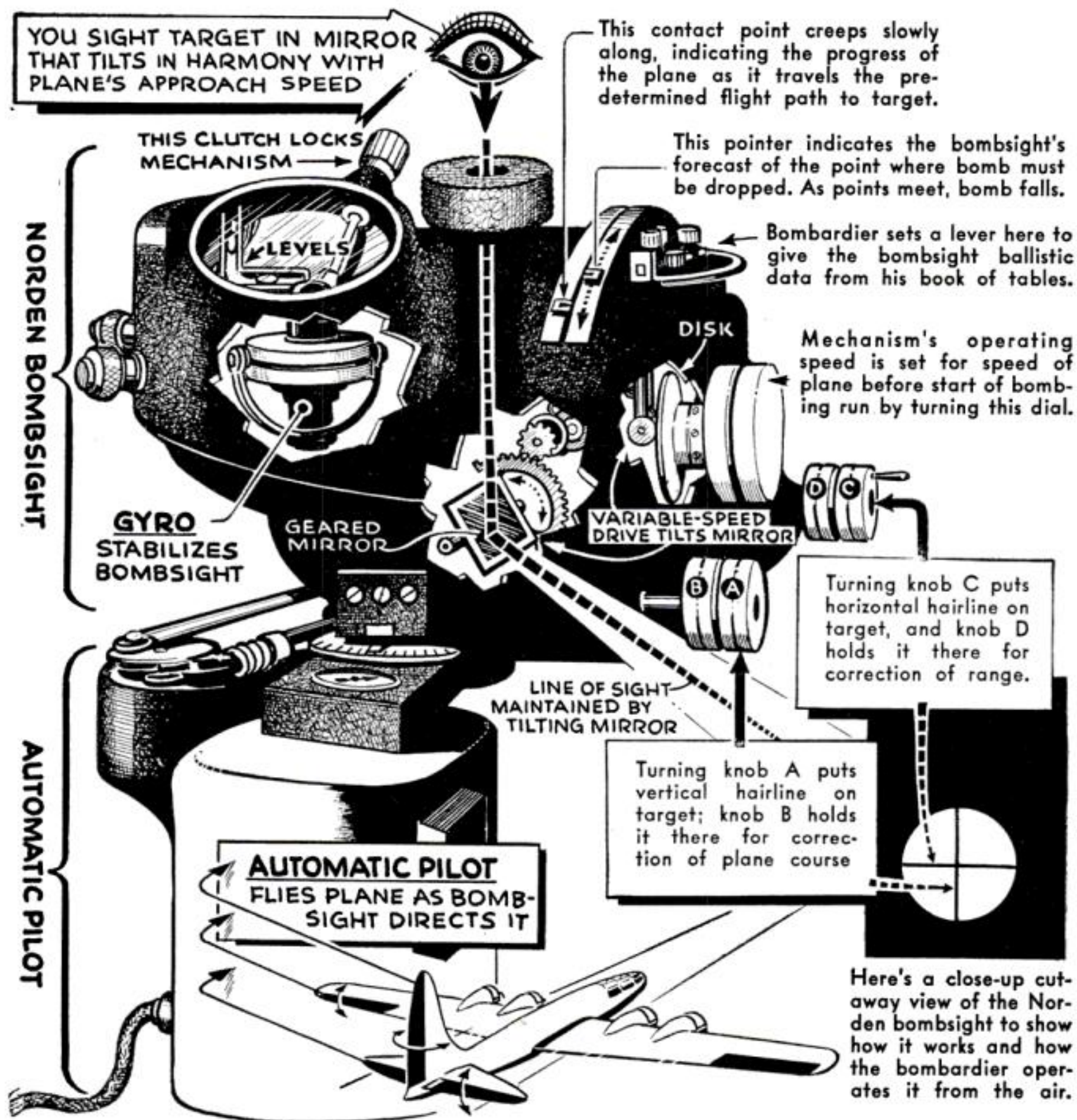
To serve its purpose of placing the bomb squarely on the target, the sight must answer two questions: on what course the plane must fly, and at what instant the bomb must be released. To do this, all the factors that affect the flight of the bomb must be taken into consideration. Once the sight has made these calculations, it becomes, in effect, an alarm clock set to drop the bomb at the correct instant. When synchronized, the sight flies the plane and operates the bomb release.

RANGE



COURSE





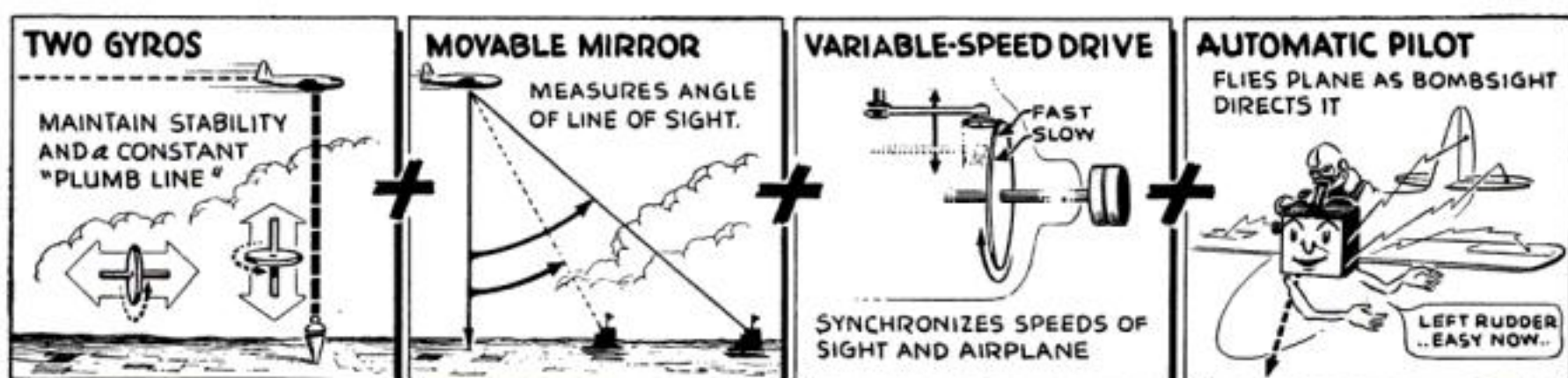
right time to place it just on the target.

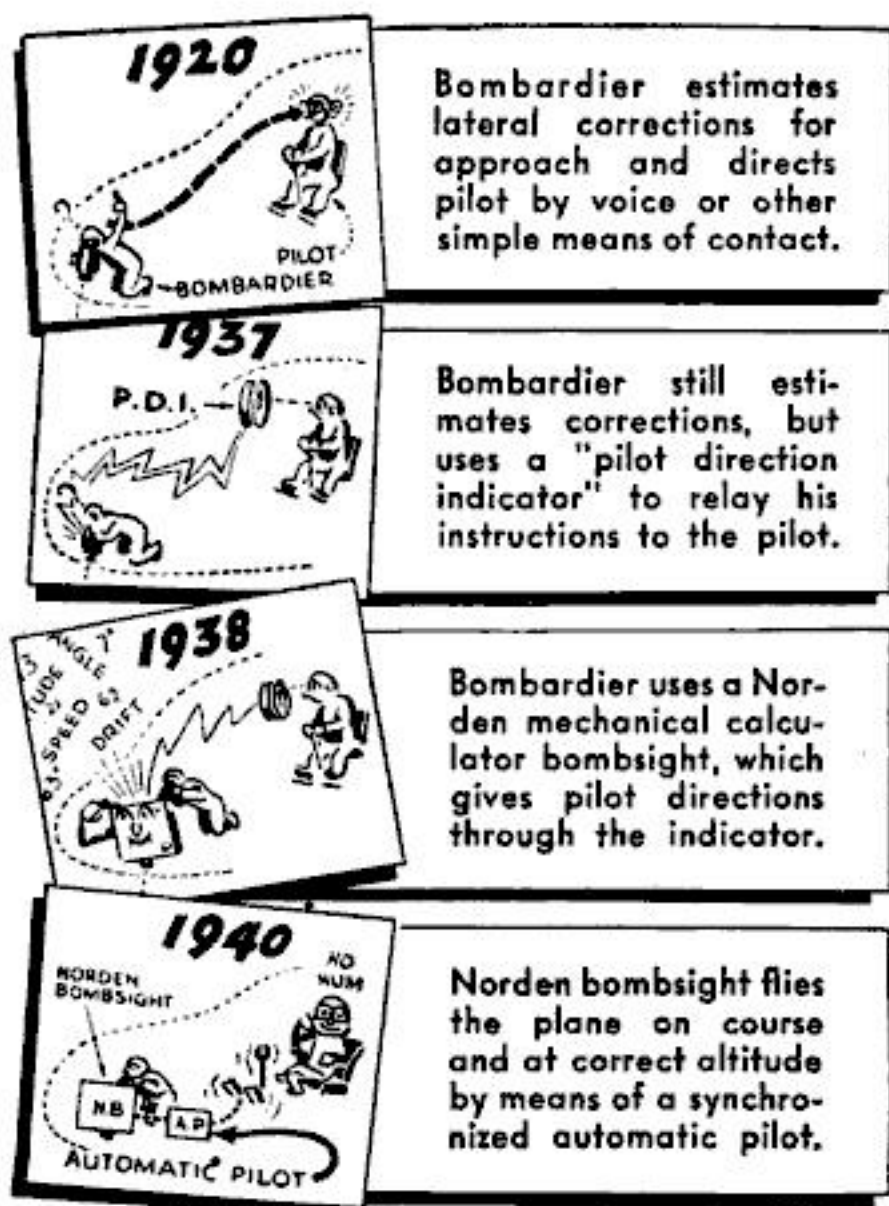
A bombardier using this bombsight bends forward as though he were looking through a hole in the floor. But, instead of seeing things rushing by directly below him, he sees a small area far ahead. He selects his target, and turns two knobs until his view of it remains as steady as it would be

through a telescope mounted on top of the Empire State Building. As surely as two and two make four, a bomb will then be released where and when the laws of physics will carry it to that target.

The Norden sight, developed by the U. S. Navy, is a queer-looking, football-shaped device no bigger than Charlie McCarthy,

FOUR MAIN ELEMENTS OF THE NORDEN SIGHT AND WHAT THEY DO





EVOLUTION OF THE BOMBSIGHT. It's a far cry from the crude bombing technique of the early 1920's to the precision work of this war.

which can be carried around in a satchel. It works just the same whether it is in a bomber several miles above Tokyo or in a training machine a few inches above a picture of Tokyo. And this fortunate fact is helping America's bombardiers become highly skilled.

Last fall, a new training machine was perfected to enable Army Air Forces men to practice operating the Norden sight. It consists of a regular bombardier's compartment perched above one end of an almost flat surface about the size of a double bed.

An aerial photograph of New York City was projected onto that bed in a recent demonstration of the training machine by

bombsight experts of the Air Technical Service Command at Wright Field. The man in the bombardier's compartment saw the building occupied by **POPULAR SCIENCE MONTHLY** in a far corner of the big picture. He set the Norden sight so that two hair-lines remained centered on that 12-story building, even though the picture was being shoved toward him all the while.

When he raised his head, the skyscrapers of New York seemed to be rushing toward him, as they would if he were approaching the city in a plane. But when he looked through the sight, the target building seemed to be standing still.

In a few seconds, this part of the photograph was almost directly under his feet. Then a light flashed—to indicate that an imaginary bomb had gone right through the office of the editor at 353 Fourth Avenue, New York 10, N. Y.

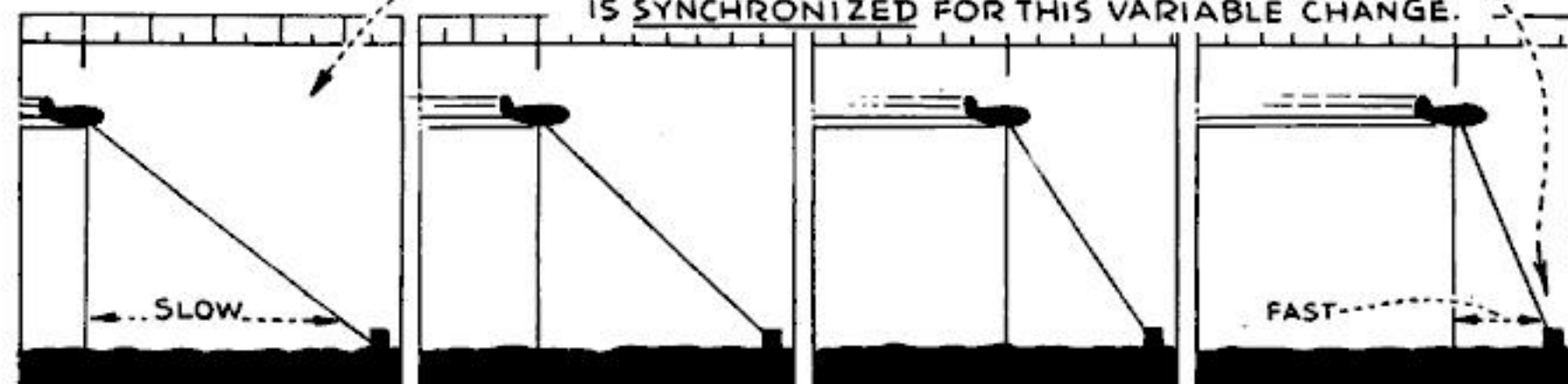
The illusion that the plane's position relative to the target was not changing had been produced by maintaining a constant line of sight between the bombardier and the target. And this illusion had enabled the mechanism within the bombsight to solve both the "course" problem and the "range" problem.

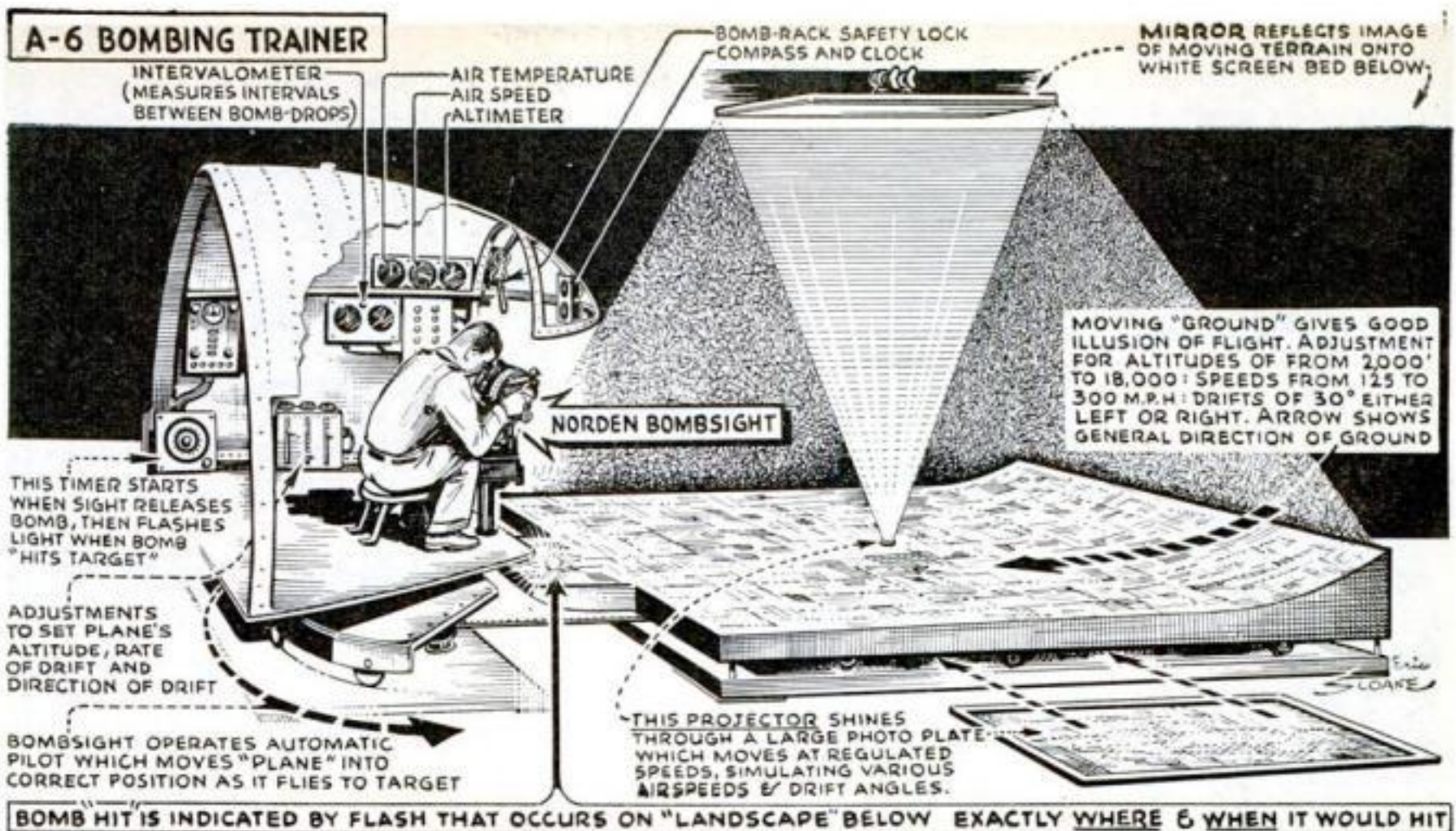
You will readily see the value of a constant line of sight, if you make yourself a bombsight. You need only a tube of paper about an inch in diameter, a ruler, a paper clip, and an office chair. Attach one end of the tube to the ruler with the paper clip so as to form a T. Seat yourself in the chair, choose a spot on the floor several feet away as your target, and pretend that your chair is an airplane.

Take one end of the ruler in each hand and hold it across your face so that you can see the target through the tube. Now draw your chair a few feet closer to the target. To continue to see it through the tube, you must tilt the ruler forward, so as to lower the far end of the tube.

SYNCHRONIZATION IS NEEDED to keep the crosshairs on the target as the plane rushes toward it. The nearer the bomber approaches its prey, the faster the line of sight moves through its arc and reduces its angle with the vertical. In the Norden bombsight, the synchronization takes care of this.

LIKE TELEPHONE POLE AS SEEN FROM A SPEEDING CAR, AN AERIAL TARGET FIRST "APPROACHES" SLOWLY, THEN WHIZZES PAST. THE NORDEN BOMBSIGHT IS SYNCHRONIZED FOR THIS VARIABLE CHANGE.





TRAINING BOMBARDIERS in the air is a costly business—about \$150 an hour. Money and time are saved by the A-6 trainer, which duplicates the conditions of actual bombing as shown in drawing.

Now pretend that a strong wind is blowing from your right. Obviously, you must turn your chair (or plane) to the right to keep that wind from blowing you off the course toward the target. So, to continue to see the target through the tube while pulling your chair forward, you must now swing the far end of the tube to the left as well as downward. You can do this by extending and raising your right arm, and retracting and lowering your left arm, during your imaginary flight.

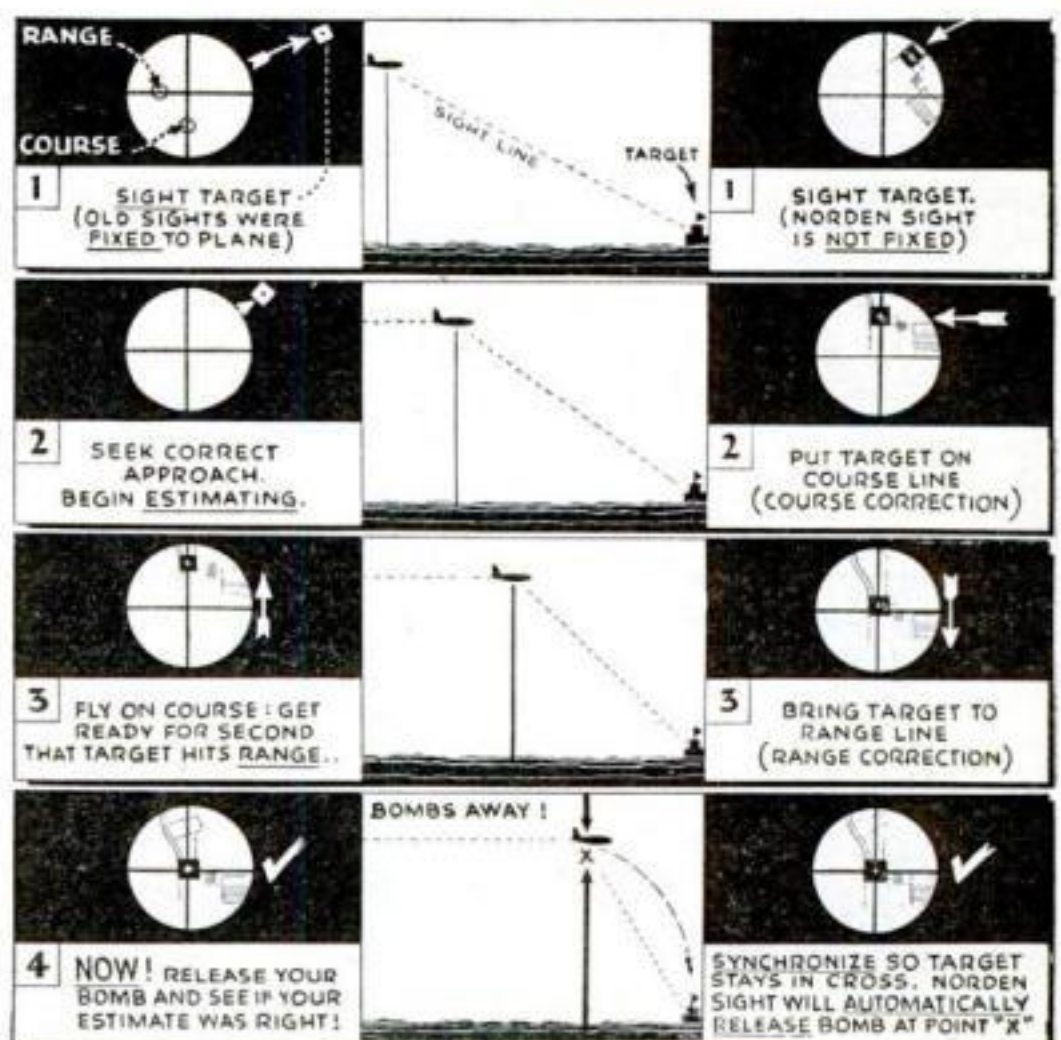
Sit still now and recall what you have done. You have maintained a constant line of sight between yourself and your target while approaching the target through the atmosphere at a constant altitude. You have done this by turning the ruler three ways at once: tipping it forward, extending one end of it farther from your face while drawing back the other end, and raising one end while lowering the other end.

The line of sight enabled you to pull your chair along a proper course even though you pretended a wind was blowing and pointed the chair a different way. The line of sight did this by telling your eyes what signals to send to your brain, and your brain issued the necessary orders to your muscles.

COMPARISON of bombing technique with old-type fixed sight (in left-hand panel) and with Norden variable sight. Because it gets on the job at the very beginning, the variable sight relieves the bombardier of most of his worries.

The Norden bombsight operates similarly. When it is adjusted so that a line of sight is held constantly between a moving plane and a target, the bombsight sends electrical signals to an automatic pilot. Like your brain, the automatic pilot then issues certain orders. It sends them to the steering apparatus of the plane, rather than to human muscles, but the result is similar: The plane approaches the target along the desired course.

In computing this course, the Norden sight even allows for the effect of wind on the airplane and on the bomb after it leaves the plane. *(Continued on page 220)*

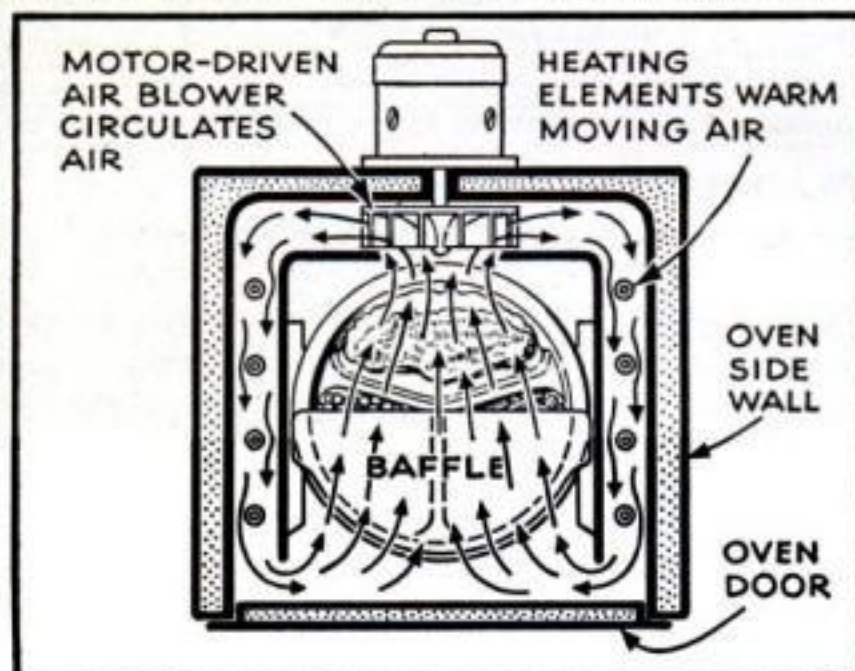




SKY PLATE holding individual portions of meat and vegetables, precooked to within a brief period of the total time necessary, is put into Whirlwind oven. Dinner is thawed and given the necessary final cooking in 15 minutes, then served on same plate.



SEALED COVER protects frozen food in the sprucewood plate until it is used. Below is a cut-away view of the Whirlwind oven as seen from top.



MAGIC OVEN HEATS "SKY PLATES"

AFTER the war, a man may bring home unexpected dinner guests—and escape the well-known icy stare. His wife will merely have to take the necessary number of Maxson "Sky Plates" out of the refrigerator, slip them into racks in her stainless-steel, electrically operated Whirlwind oven, and set the table. In about 15 minutes everything will be ready. Each plate holds an individual dinner—meat and two vegetables in separate compartments—that has been partly cooked and quick-frozen. The trick in thawing and finishing the cooking of the food is in the way the heat is applied and the vegetables are protected from being dried out by the circulation of hot air set up by a fan in the oven.

Sky Plates and oven were originated by William L. Maxson, engineer and manufacturer of multiple machine-gun

mounts (P.S.M., May '44, p. 84) and automatic navigation equipment. Sky Plates are now served aboard Naval Air Transport planes, and will appear in stores after the war. Gas, kerosene, and gasoline ovens will be built for large- (Continued on page 211)

Dinner is served, cooked just right. Used plate is discarded.





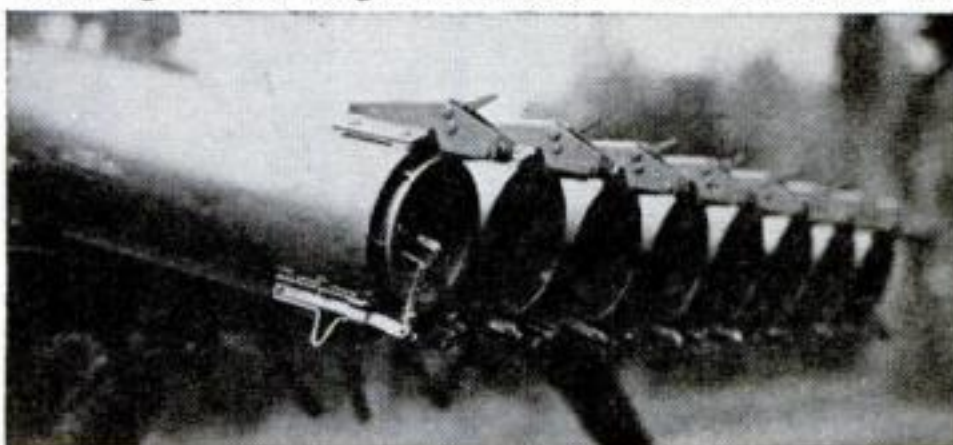
GI at control box of the new field rocket launcher grips firing pin as buddy cranks generator.

Portable Rack Fires Rockets

AN EIGHT-TUBE, stationary rocket launcher that shoots out 4.5-inchers 4,400 yards has been added to American armament in the field. A development of the infantryman's single-tube launcher (P.S.M., Nov. 1944, p. 79), this new weapon, which is fired electrically, is easily transported and quickly set up by artillerymen moving against the enemy on the heels of the infantry. Looking not a little like a section of a pipe organ, the launcher discharges its missiles singly or in a barrage, to hit with the destructive force of howitzer shells. These photographs, taken in action in the European theater, were released for publication by the Gauge and Photographic Section, Ordnance Research and Development Center, Aberdeen Proving Ground, Aberdeen, Md.



This sight aims eight-tube rack; wheel elevates it.

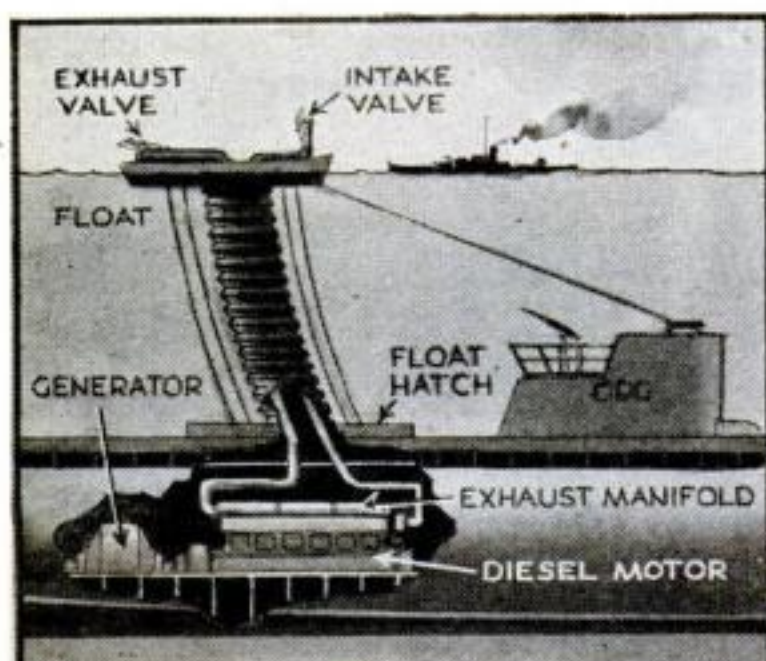


A simple clamping device holds each rocket in its tube (above). Note that the tube on the left end is loaded.

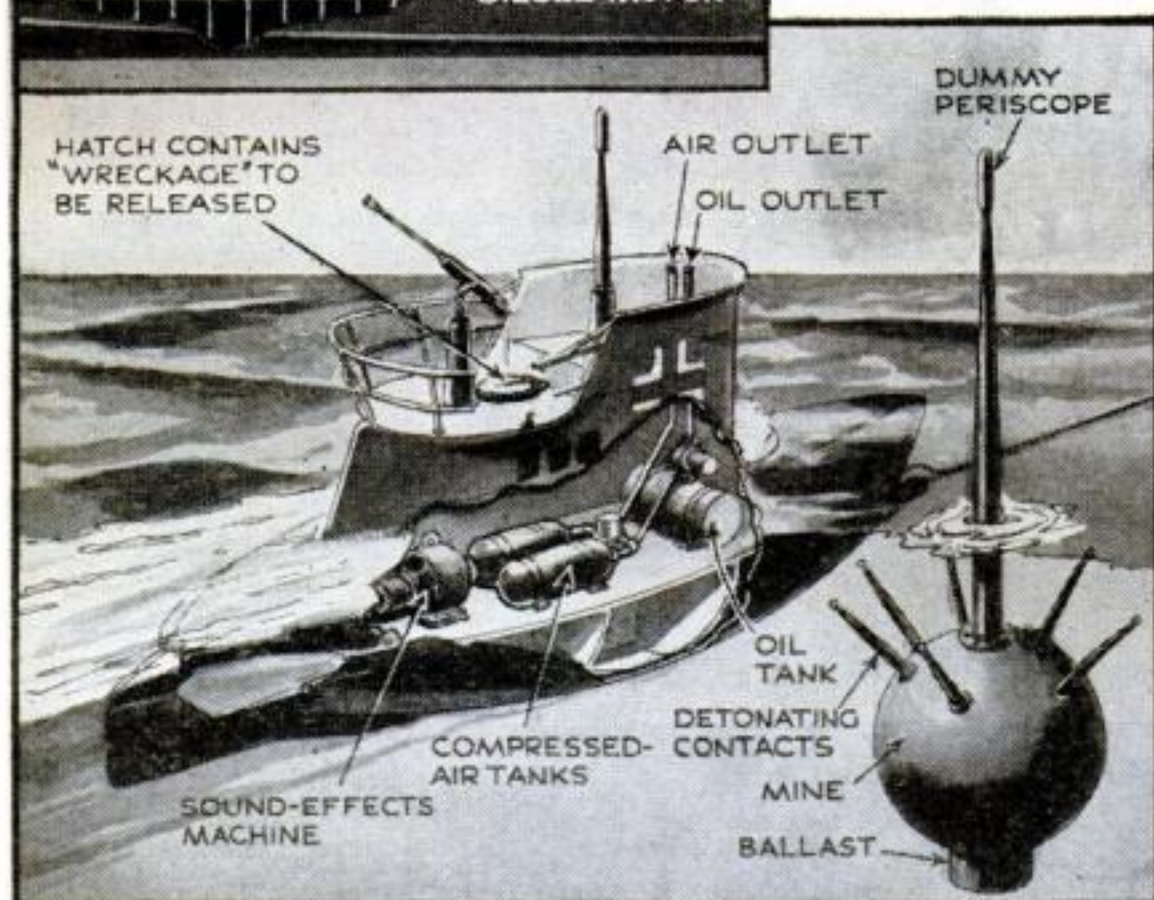
Here is some of the equipment used with the new launcher. The 4.5-inch rocket is 30 to 36 inches long, has a 105-mm. war head, and weighs over 35 pounds.



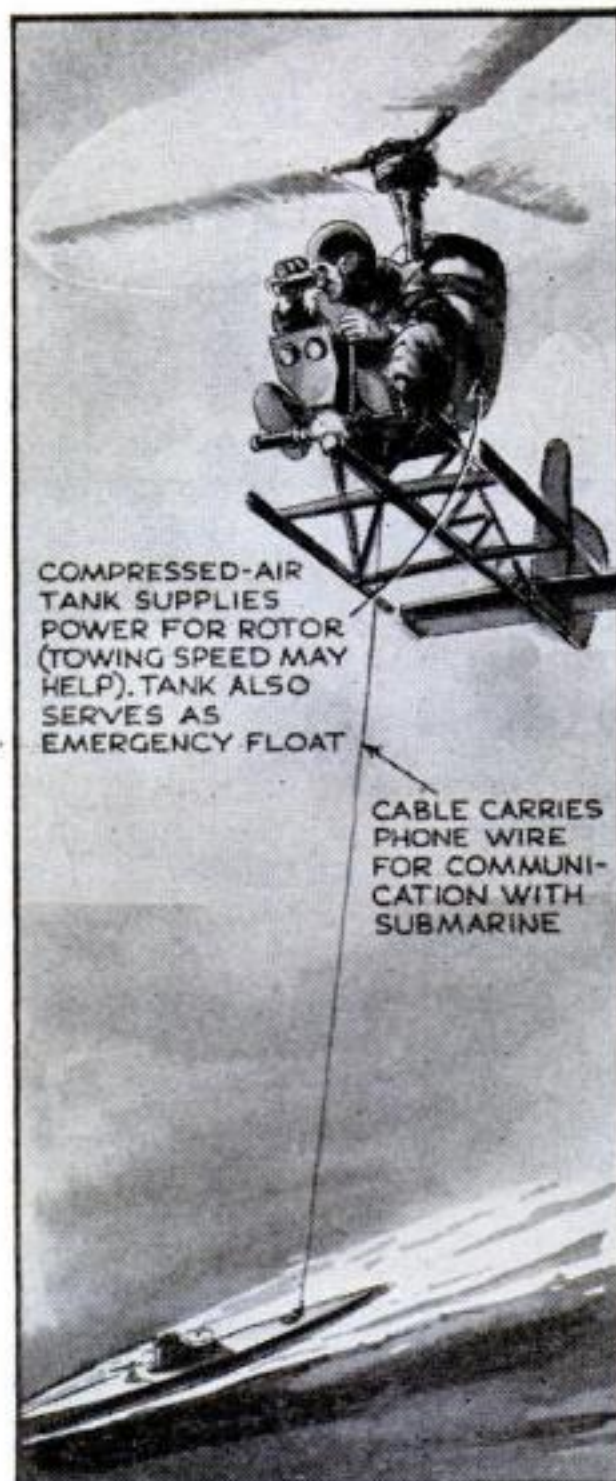
A PERISCOPE attachment on the German machine gun at the left made it possible for a Nazi gunner to aim the piece without exposing his head to enemy fire. Two mirrors, one above the trigger and the other at the top of the attachment, give a sight along the barrel of the gun. The device was used with two sizes of machine guns.



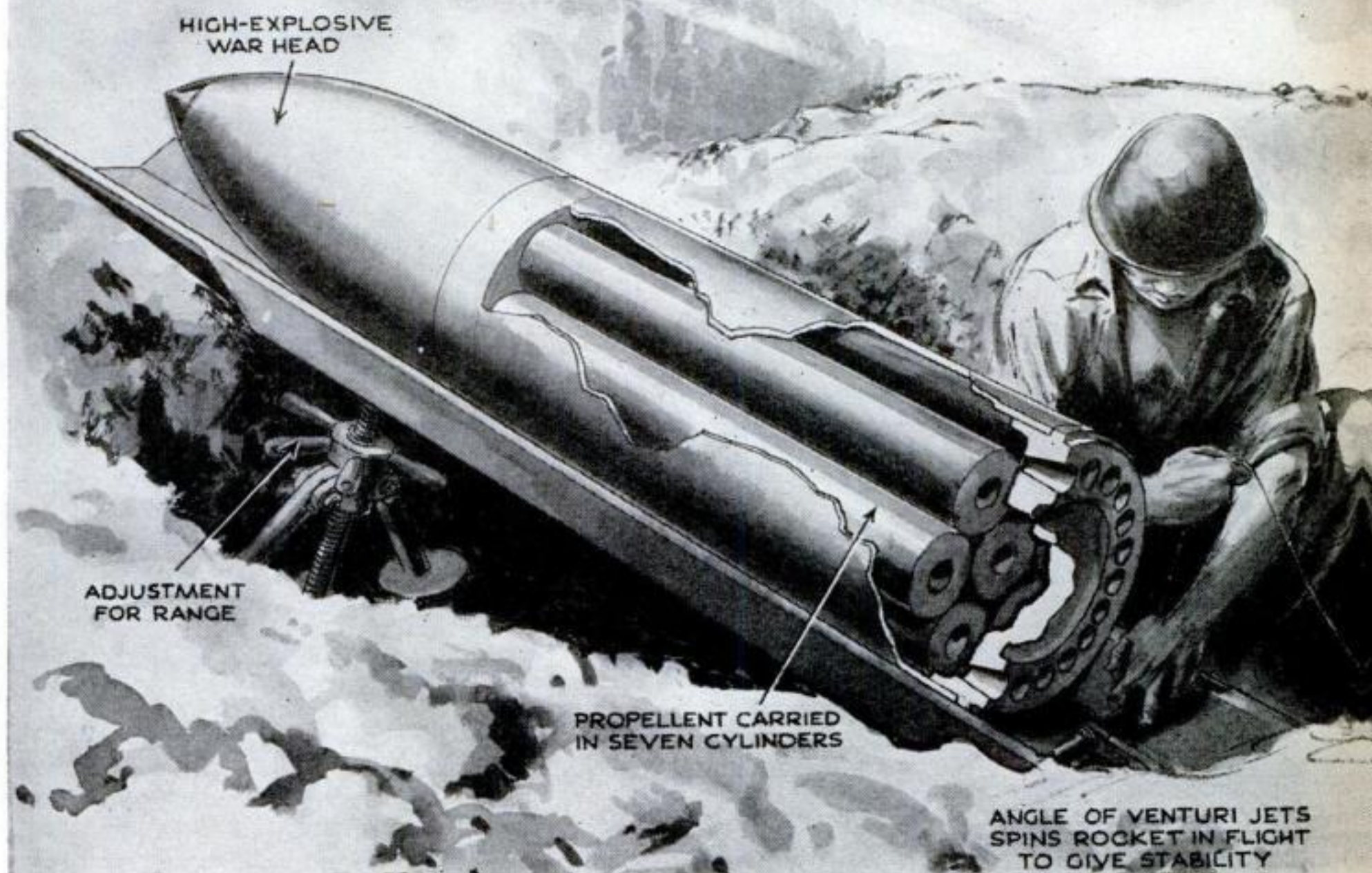
U-BOAT LUNG was intended to help Nazi subs to recharge batteries without surfacing. The picture at left shows probable arrangement, which consists of telescopic air intake and exhaust pipes.



DECOY SUBMARINE AND PERISCOPE MINE were developed by Germans to fool Allied ships. The dummy sub, towed by an undersea boat a half mile away, both looked and sounded real, for the superstructure was an exact reproduction of a U-boat's and the underwater portion carried a sound-effects machine for further deception. The mine (right) with a dummy periscope was supposed to decoy Allied vessels into ramming it.



FOLDING HELICOPTERS of light-weight alloy were carried by some subs for long-distance observation. According to some reports, these captive craft could rise as high as 1,000 feet when towed like kites and assisted by the U-boats' motion.



JAPANESE ROCKET SHELL, presumably modeled after a German design, has been used in the Philippines in small numbers. It has a caliber of 447 millimeters (about 17 inches), and weighs approximately a ton.

The picture above shows artist B. G. Seielstad's conception of the rocket's construction and method of launching. Many unused rockets have been found, and the bursting charge appears to be picric acid.

NIP MORTAR is 75.37 inches long and weighs 770 pounds. From fixed emplacements, it fires a shell weighing 56¼ pounds without the propellant and fuse. Maximum range is 2,187 yards, and the bursting radius of its ammunition is anywhere from 65 to 165 feet. Below, a U. S. Army sergeant shows how the mortar is aimed from side.





© National Geographic Society

"DUCK." Forerunner of the Army's seagoing truck navigated Alaskan waters 18 years ago with a scientific expedition. Its builder, volcanologist Thomas A. Jaggar, has received a \$1,000 award for his part in developing the "duck" (left).



Who Called Them "New"?

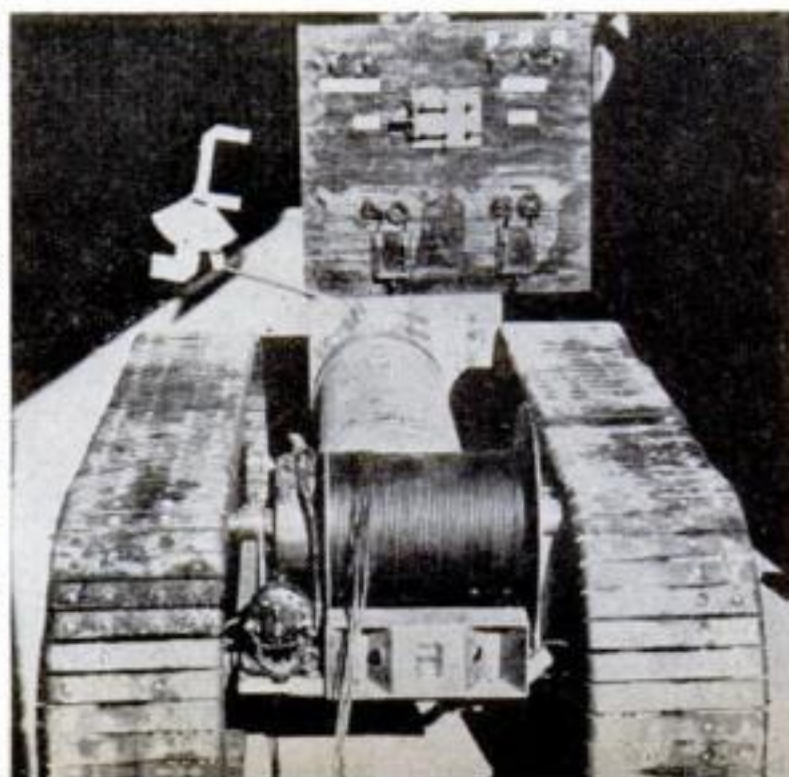
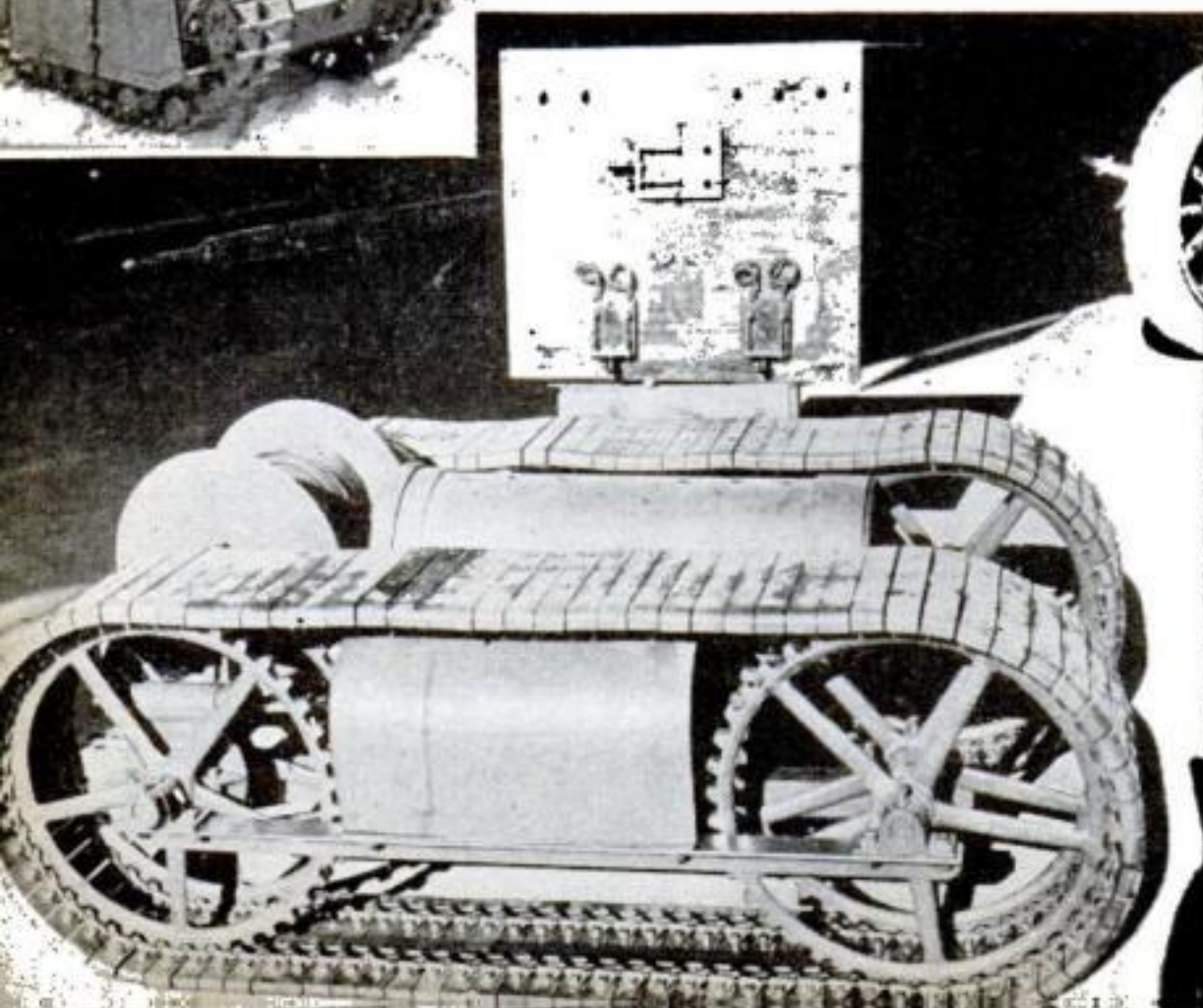
SOME of the "new" weapons of this war aren't so new, after all. The "duck" amphibious truck, for instance, is the direct descendant of the *Sea Turtle*, a strange vehicle built 18 years ago and used by a National Geographic Society expedition among the volcanoes of Alaska.

Designed by Dr. Thomas A. Jaggar, famous volcanologist and leader of the expedition, the *Sea Turtle* was a 16-foot boat built onto a Ford chassis. When it went into the water, steel paddle wheels were put on the rear axles. These kicked the boat along, while the disk front wheels served as rudders.

Another not-so-new weapon was the "beetle" robot tank tried out by the Nazis in Italy. Away back in 1918, Elmer E. Wickersham, now of the Caterpillar Tractor Co., built a "land torpedo" powered and controlled through a trailing electric cable. The Armistice came along before its military usefulness could be proved.



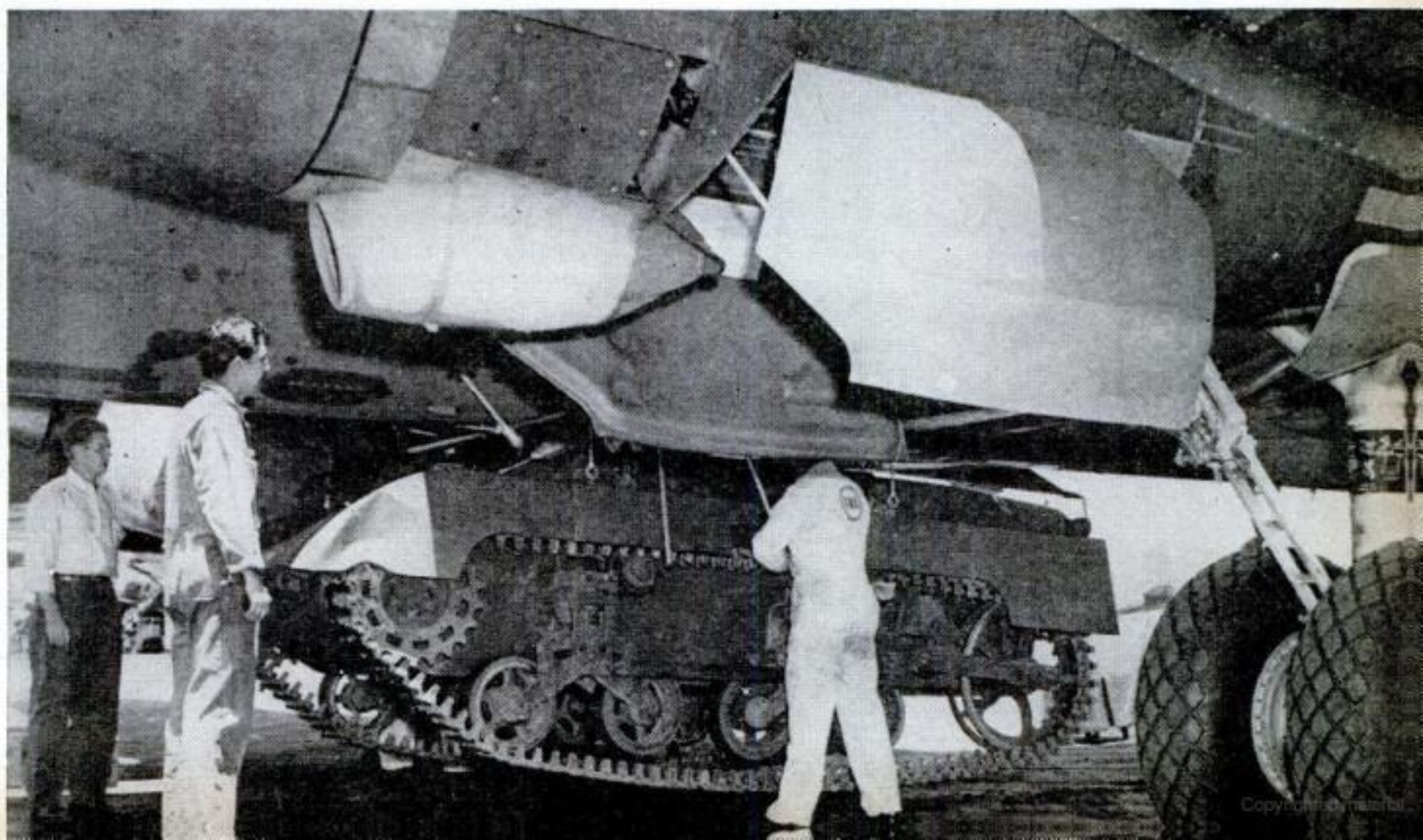
"BEETLE." The "land torpedo" below and at left was invented by an American in World War I. Inset shows Nazi version of the idea, used unsuccessfully in Italy.



MODELS TEACH SEAMANSHIP at the U. S. Maritime Service Training Station, Sheepshead Bay, N. Y. Pivoting on a platform marked off in the 32 points of relative bearing, the miniature whaleboat below comes about as its sails are trimmed to an artificial breeze.



READY TO FLY, the M-22 Locust airborne tank below is being slung underneath a Douglas C-54 Skymaster transport. With its turret removed, the tank is lifted by hydraulic jacks and snapped to a rack. Loading takes only six minutes.



B-29'S INSTRUMENT PANEL. This impressive collection of dials and controls is the engineer station on a Boeing Superfortress. Sitting behind the copilot and facing toward the rear of the plane, the flight engineer keeps the power plant and other mechanical features of the plane working properly, leaving the men in the nose free to concentrate on flying technique and combat strategy.

WHAT'S NEW



THE NEW THUNDERBOLT P-47N, developed by Republic Aviation and the Air Technical Service Command, has a combat range of over 1,000 miles and speed above 450 m.p.h. Added range was obtained by redesigning the wing section, increasing the span by 18 inches, and adding 22 square feet of area. Eight new fuel tanks were added. The new Thunderbolt carries 10 five-inch rockets (see photo), eight .50 caliber machine guns, and two 500-pound bombs.

A CONTROLLABLE WING takes the place of ailerons, rudder, and stabilizer in an experimental light plane designed by George Spratt for the Stout Research Division of Consolidated Vultee Aircraft Corp. Test flights were made recently near Kitty Hawk, N. C., where Spratt's father, Dr. George A. Spratt, collaborated with the Wright brothers in developing their plane. The designer has logged over 100 hours of flying time with this new wing, although he cannot fly a conventional plane.



IT'S CLOSE QUARTERS, but this new plan for carrying men and supplies in wing tanks turns the already versatile P-38 Lockheed Lightning into a transport. Specially designed tanks with transparent noses, carried under the wings like auxiliary fuel containers, enable a P-38 to transport 10 men or an equivalent amount of supplies, so that fighters can move into a newly captured base with their own ground crews and equipment. (P.S.M., April '45, p. 82.)

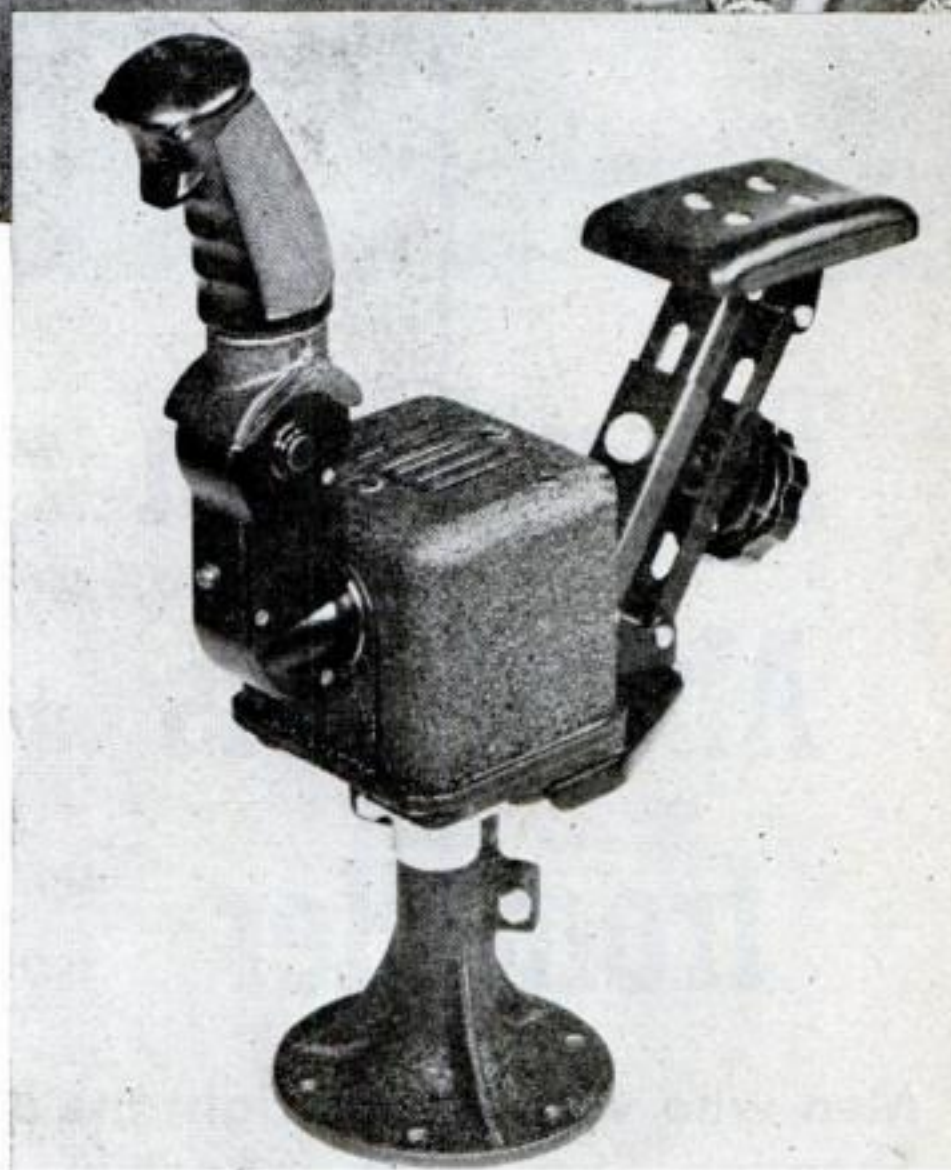
IN AVIATION



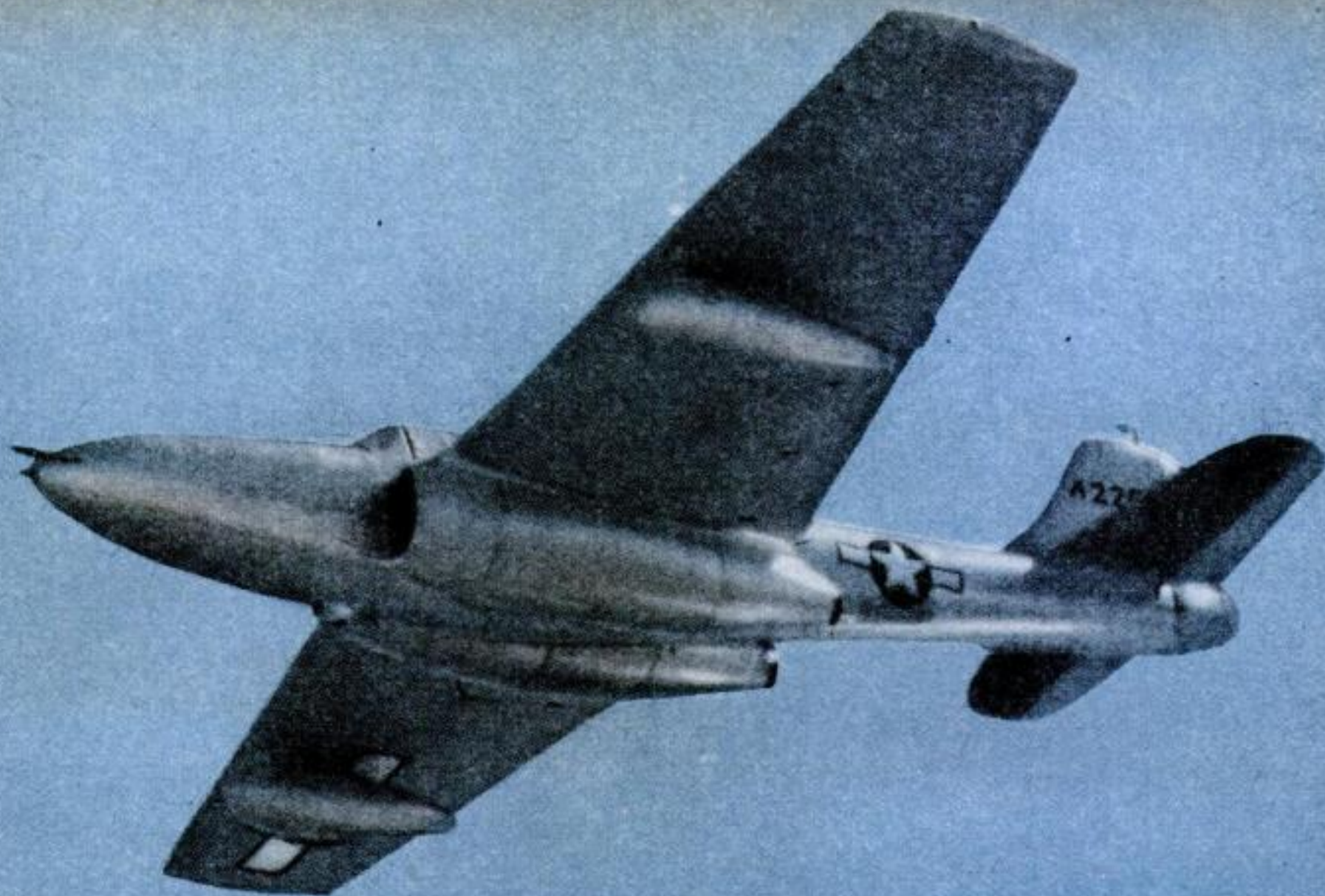
FORMATION STICK. Flying a big four-motored bomber in tight formation for long distances is said to be as easy as riding a bicycle, thanks to a new control device developed by the Air Technical Service Command and the Minneapolis-Honeywell Regulator Co.

Installed in the pilot's and copilot's compartments, the "formation stick" consists of a pedestal bearing a control box, an arm rest, and a pistol-grip "stick." Used in the same manner as the "joy stick" of a small plane, it employs electronic amplification to work the plane's controls through the same servomotors that obey the automatic pilot on bombing runs.

First installed on B-24 Liberators, the "formation stick" will be used on other four-motored bombers, including the B-29 Superfortress, to reduce pilot fatigue.



"THE RUNT" trains ground-crew men for C-54 Skymaster transports in the Army's service school at the Douglas Santa Monica, Calif., plant. The earthbound mockup is a hybrid—a full-scale C-54 forward section with the outboard wing section of an A-20 and four midget engines of farm-pump caliber. Operation of the engines is recorded on the instrument panel as if they were 1,350-hp. Skymaster power units.



They Learn About Jets from Her

Men who will fly and fight the Shooting Star go to school in our first jet job, the P-59.

By HAL BORLAND

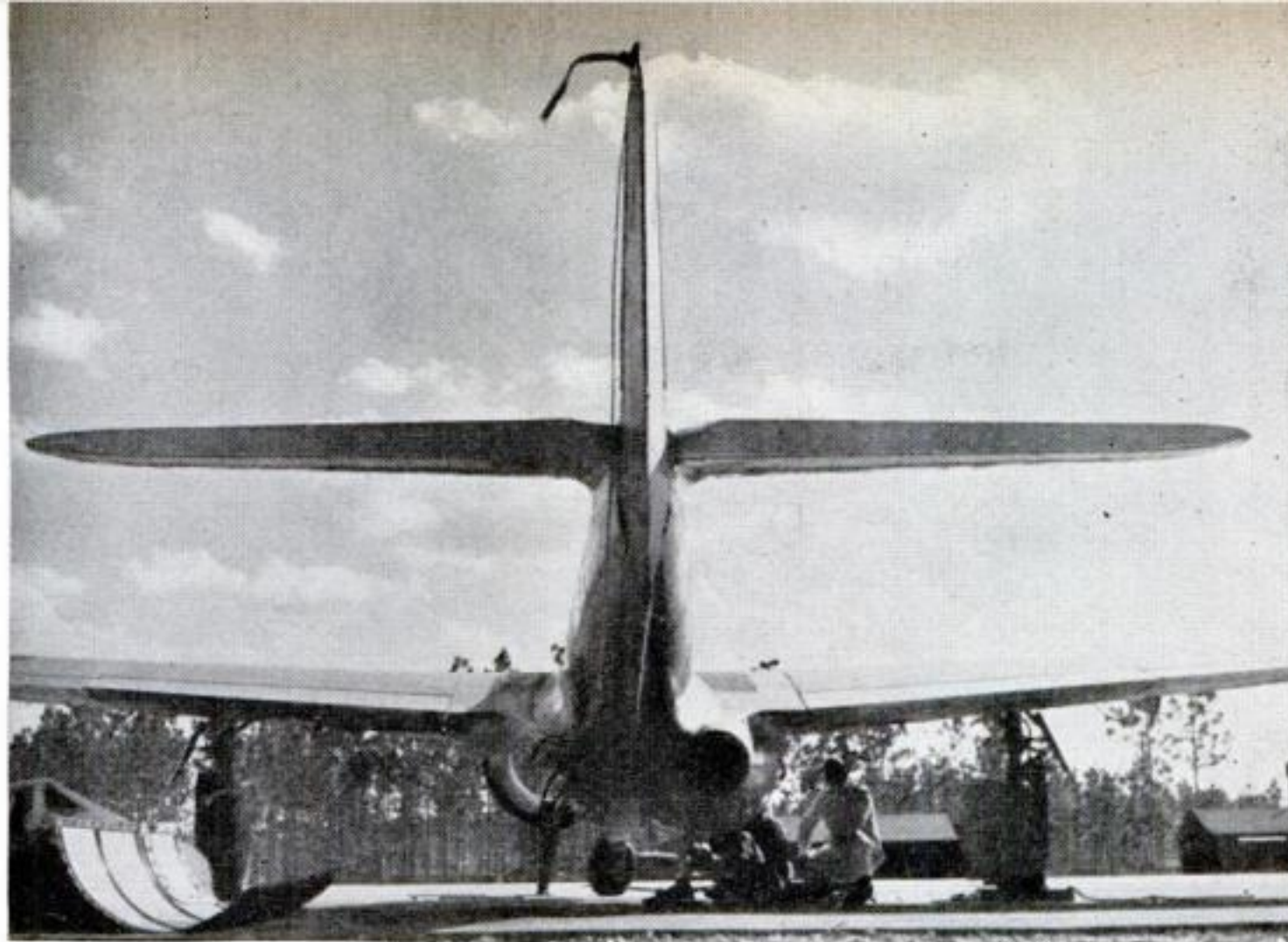
AERICAN jet-fighter pilots, who soon will be taking the new P-80 Shooting Star into action, learned their stuff in the P-59 Airacomet, the Army's twin-engine jet fighter-trainer. For months tests have been run, tactics developed, and pilots checked out on the P-59. It has been the primary test ship for our present jet program, and lessons are still being learned from it, both on the ground and in the air.

On the ground, it's not a particularly impressive plane. Unusual, yes, for it looks a

bit like a Kingcobra's fuselage with mid wings and no prop and unusually stubby landing gear. Seen from the front, it seems to goggle at you from two vacant, close-set eyes, the intake ports for the engine nacelles, which are faired into the fuselage just under the wings. In side view, it has a sway-back appearance, for its tail rides high to clear the blast from the engines.

Then the starters whirr and the engines spit flame, a few seconds of orange fire that roars away into a shimmer of blue heat. Dust whips up 75 or 100 feet back of the plane. Brakes are released and the ship lumbers away, turns awkwardly down the runway. She quickly gathers speed, lifts, and is airborne. Up she goes, at an astonishing angle of climb. Suddenly you realize that there goes the jet ship, an airplane without a propeller, without a piston, without anything like the engine you always considered necessary to take a plane into the air and keep it there. This ship has "squirted" itself into the air with a couple of outsize oil stoves and a pair of whistling fans. In fact, its most noticeable noise is the tinny whistle you associate with the sudden acceleration of a big electric fan. And when it really gets going you don't hear even that sound until the ship is past you. Then you hear that strange rumbling roar peculiar to the jet ships, the growl of violently disturbed air that sounds like a freight train between two high hills.

The ship climbs swiftly, levels off, gathers speed. The pilot puts it through maneuvers,



EXIT PORTS of the two jet engines snuggle close to the trim fuselage. This arrangement gives exceptionally good performance on only one engine. Note slight dihedral of the wing.

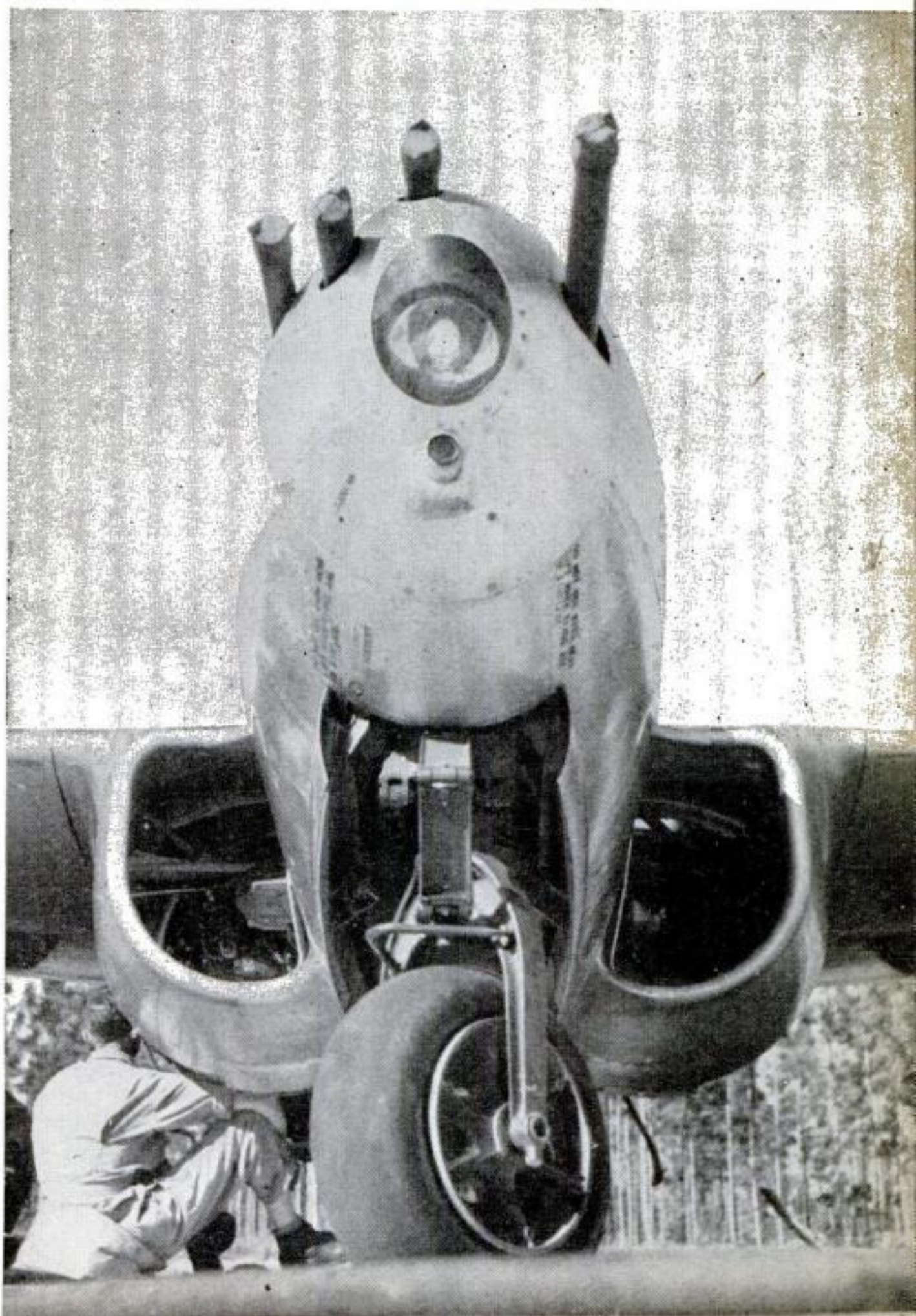
AIR INTAKES are seen in the nose view below. Engines sit so near the ground that mechanics use garage "creepers" for servicing. Nose landing wheel retracts into plane's fuselage.

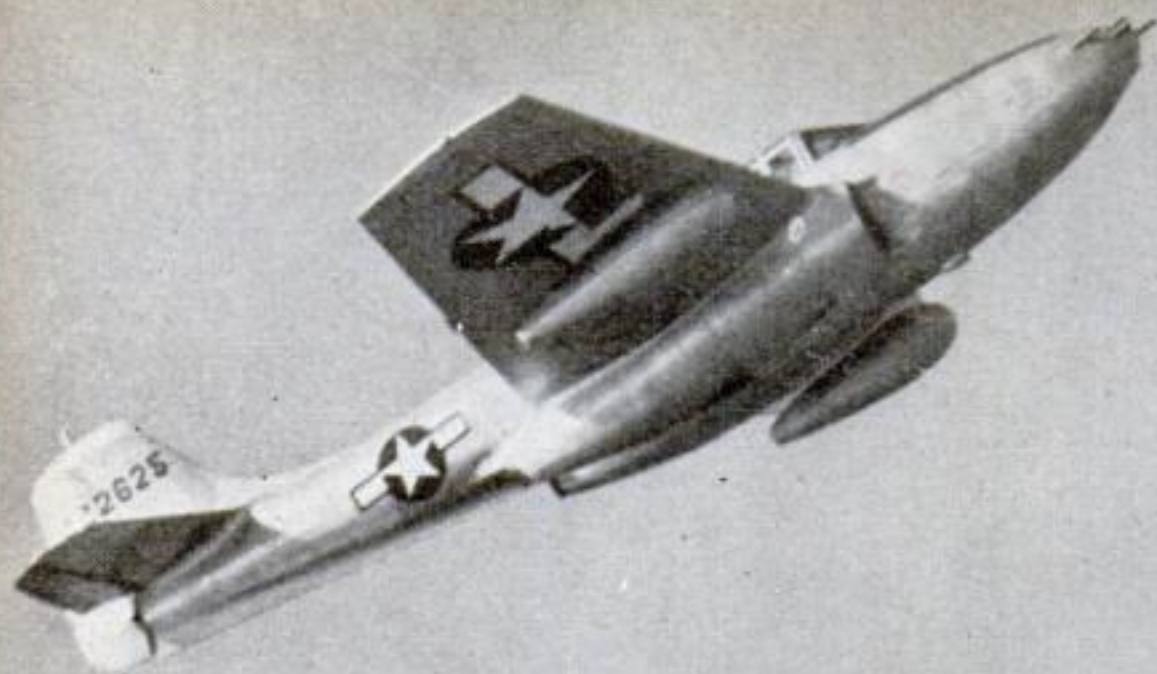
◀ **IN THE AIR**, the Airacomet reveals wide, square-tipped wings and tapering, long nose. This one carries auxiliary tanks.

just to show you its paces. No doubt about it, the Airacomet handles with remarkable ease at conventional speeds. Then he goes on up, where the air starts to thin out, and he begins to open her up. She looks like a gnat up there, a silvery gnat in a great hurry. She streaks for the far horizon, and you realize that the talk about jet-plane speed is more than talk.

Then she comes back, in a wide sweep over the field, losing altitude very slowly. One sweep, and another, and still she is gliding in; and then she comes leisurely down toward the runway, killing speed, dropping in almost like a glider. Down, down—still with a lot of lift, although she seems to be coming in no faster than a Cub plane. Then she is in. She sort of hunches down, sets her wheels on the ground, quivers a little, and rolls down the runway to a stop.

Technically speaking, the P-59 is a mid-wing





CLIMB is one of the strong points of the jet plane. A pilot says: "It can outclimb anything else I've ever seen." With its speed and high ceiling, this gives it the edge over propeller-driven fighters. The sway-back look noticeable in this picture is due to the fact that the tail surfaces are placed high so that they will escape the searing blast from the jet engines.

monoplane with a span about three feet less than that of a P-38. As it comes off the assembly line, the P-59 weighs about five tons. It has a tricycle landing gear with wing wheels exceptionally far apart. Landing gear is fully retractable. It is a single-place ship with conventional-type controls. Horsepower of its twin jet engines is undisclosed, but the somewhat larger engine in the single-jet P-80 is said to develop around 4,000 horsepower. Top speed also is undisclosed, but both German and British jet ships are known to be able to top 500 miles an hour. Officially, the P-59 has "over 400 m.p.h." Its speed and efficiency increase with altitude, and its ceiling is officially listed as over 40,000 feet. Pilot's compartment is pressurized, but the pilot uses oxygen even at the usual levels for the simple reason that the oxygen in the cabin's air is soon exhausted.

Mechanics fall in love with the ship. The engines are unbelievably simple, having only two moving parts, the impeller or compressor, and the turbine which drives it, both attached to the same shaft. All told, the jet engine has only about one tenth as many parts as the conventional reciprocating engine. A whole engine can be removed from the P-59 in just a bit over half an hour, and the mechs say they can remove and replace both engines in a short day. Further, they don't need a mech stand to work on these engines. Actually, they use a garage mechanic's "creeper" for a good deal of the work, because the engines are so low the mechanics work flat on their backs a good deal of the time.

The jet engines will operate on almost any inflammable hydrocarbon, but kerosene



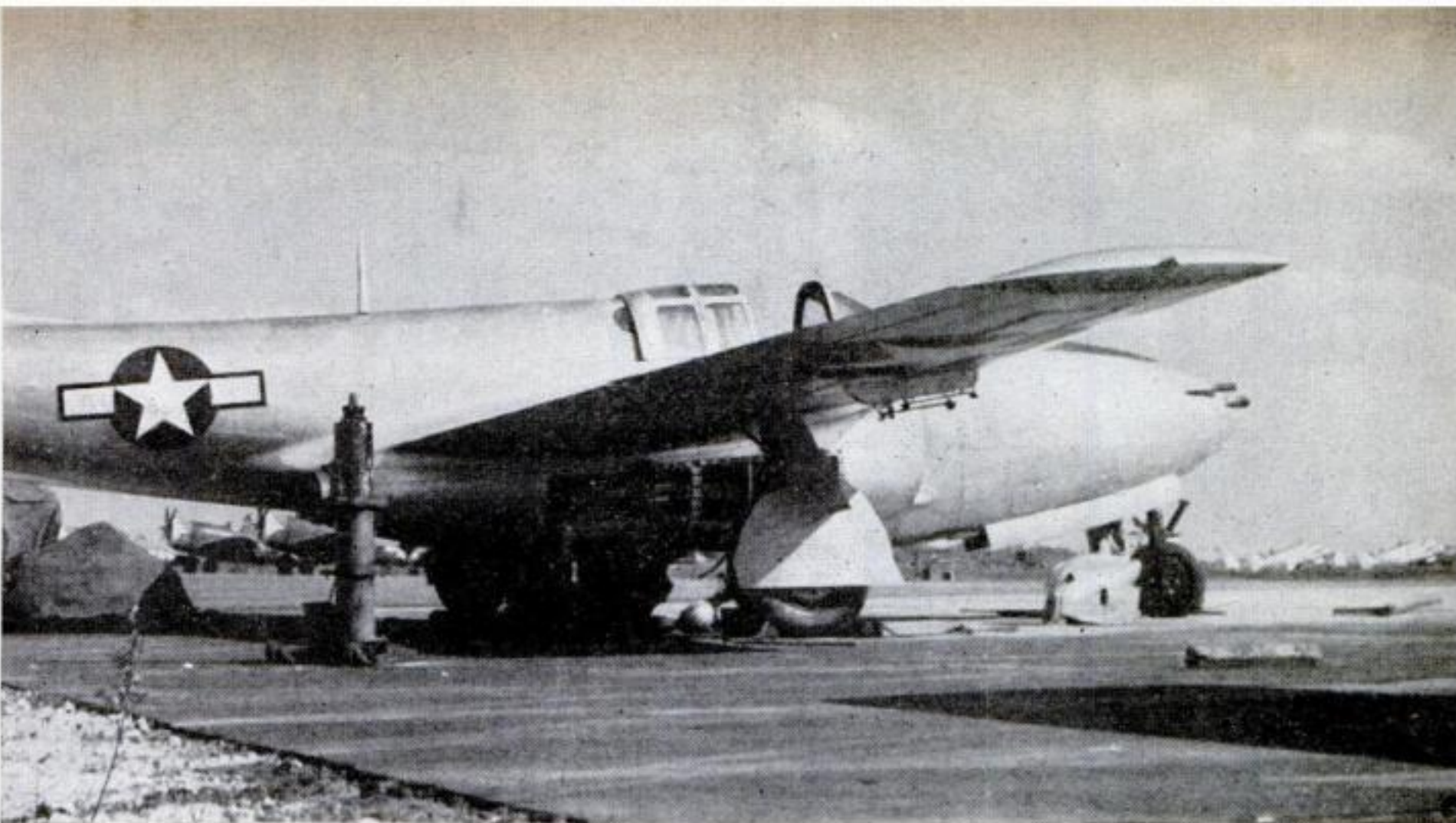
SERVICING the P-59 is a cinch. Each engine has only two moving parts.

has been used and found most satisfactory in most of the test and tactical work done at the Air Forces Tactical Center in Florida. Pilots and engineers say, however, that they can run the ship on anything from hair tonic to brandy.

Pilots have many kind words for this ship. "It handles as easy as a glider," one pilot says—adding, "at average speeds." Actually, at the speed of a conventional plane it seems to handle with exceptional ease, and the boys say it takes them back to "stick-and-rudder days." Complete lack of torque contributes to its easy performance. Other factors are low wing loading and lack of propeller drag. It has such a flat glide that some of the pilots will tell you it coasts three times as far as the ordinary pursuit ship. This is evident when you watch the ship land; it has to stall around and kill speed for an unusual time before it settles down. Most pilots overshoot their mark the first few times they try to land it. This is also caused, in part, by the short landing-gear struts. The jet plane sits much closer to the ground than propeller-type ships.

The P-59 has unusually good stall characteristics. Pilots say it gives ample warning, shuddering, then falling off straight ahead without yawing into a spin. "When you want to spin," says one pilot, "she handles like a baby buggy. I've turned out of a five-turn spin in three quarters of a turn. On accelerated turns, though, you've got to watch your step. When you're hitting 400 m.p.h. you reach four G's (four times gravity's pull) in a hell of a hurry. Just a few seconds of that and you black out, unless you've got a G suit to protect you."

There is virtually no engine vibration in



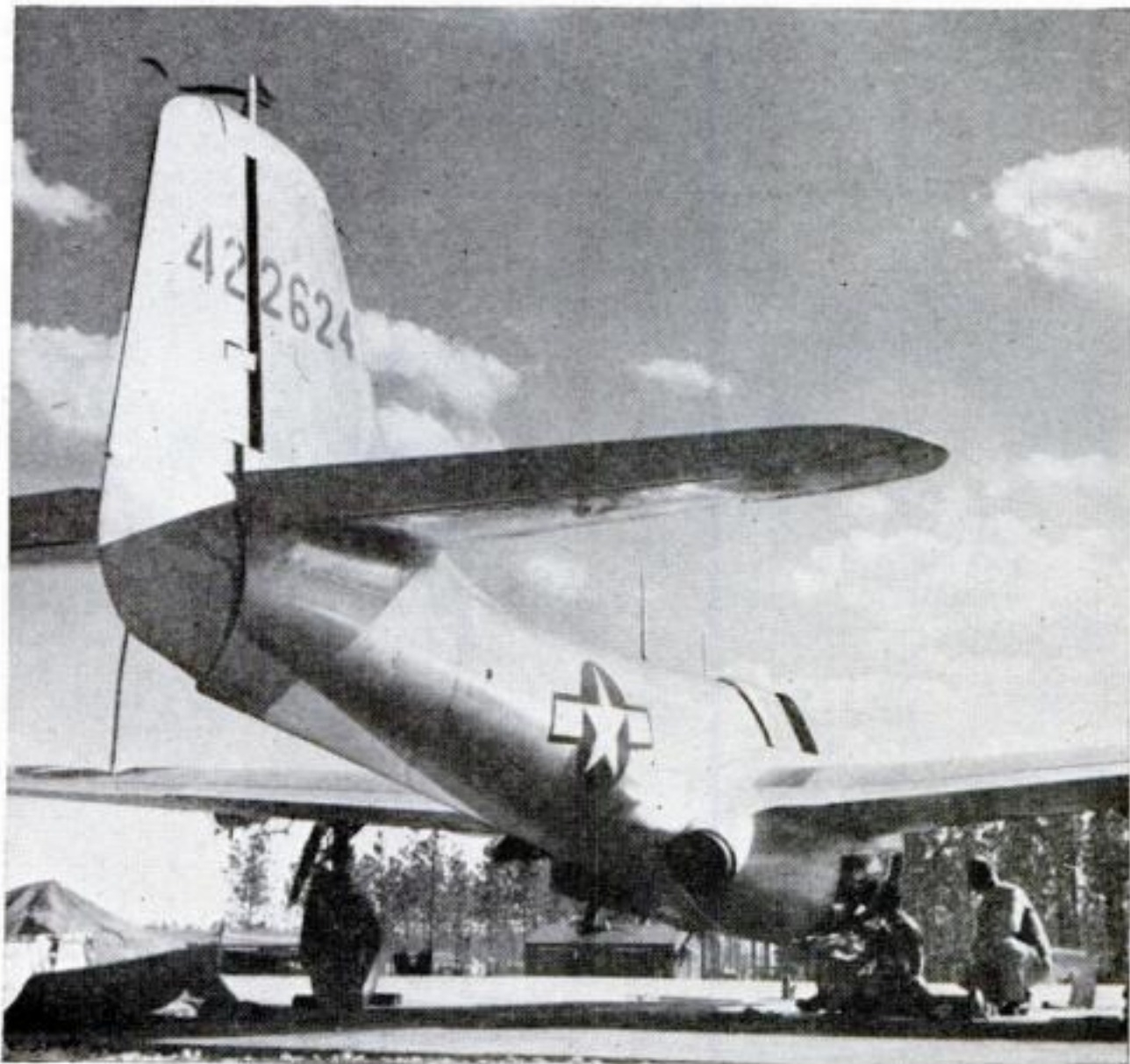
An engine can be removed in about 30 minutes, and it is a short day's work to take out both and install new ones. In this picture the engine covers have been removed. Few tools are required for maintenance.

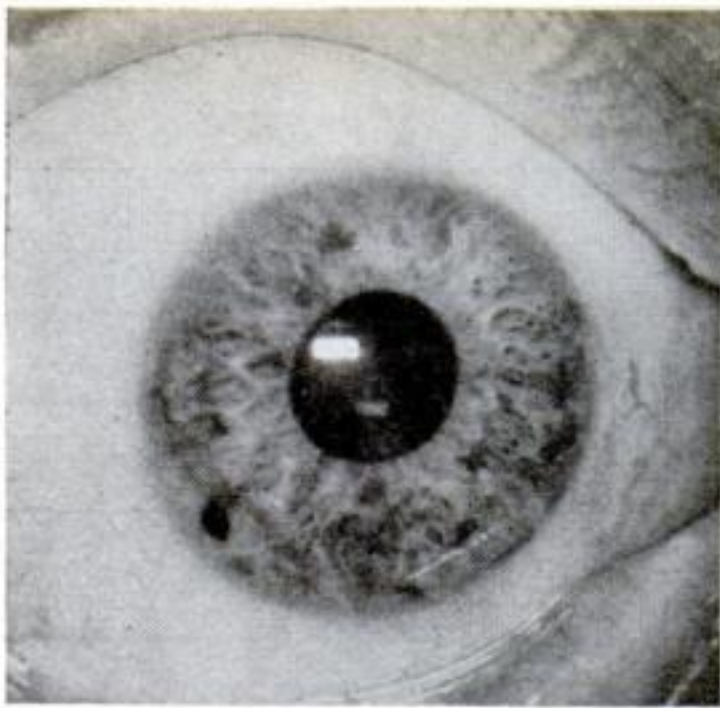
a jet plane. About the only noise is the swish and roar of air on its wings, with the background rumble of the jet engines' power exhaust. Lack of vibration greatly lessens pilot fatigue and improves pilot efficiency and reaction. Again, the pilots liken the feeling to glider flying. At conventional speeds, that is, above 400 miles an hour, it's something else again. This lack of vibration raised an unusual instrument problem in the P-59. The pilots had to put "rattlers" on the instruments to make sure they were working; they didn't trust them without the usual vibration rattle.

The P-59 is a twin-jet job, but she can fly and land on one jet. "And she has plenty of speed on one," the pilots assure you. Because the two jets are snuggled close to the fuselage instead of out on the wings, the failure or cutout of one jet does not greatly alter the flying characteristics of the ship.

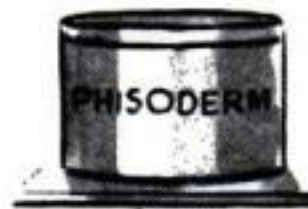
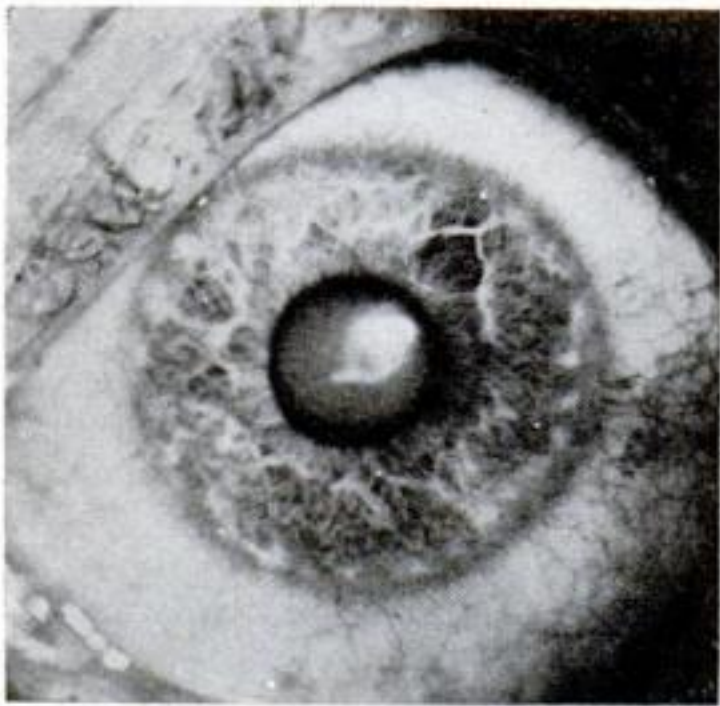
LANDING GEAR. Main landing wheels are set far apart under wings. Struts are short. Large tail control surfaces make it as easy-handling as a glider.

Those who see the jet ship for the first time often wonder about the suction of the engine intakes and the blast from the jet nozzles. There is a strong suction at the intake, and in the air it might conceivably gobble up a few birds. To prevent this, protective screens are used. The nozzle blast is dangerous—as dangerous as the arc of a whirling propeller. Anyone walking into that blast 20 feet *(Continued on page 212)*





EYEPRINTING. The colored part of the eye—the iris—is as individual as the fingerprint and could be used for identification in the same way, according to Dr. Reuel W. Bennett of the American Optical Co. The photos above and below show two distinctive patterns.



SOAPLESS CLEANSER. A new synthetic skin detergent, known as pHisoderm, which cleanses thoroughly and more quickly than soap, has been developed by Dr. B. Thurber Guild, president of Fairchild Brothers and Foster. It is produced in the form of a thick, fluid cream which contains no soap, no fatty acids, no alkali, and no perfume or coloring matter to produce allergy. The cream comes in two types—regular (for average skin) and oily—and is active as a cleanser in hot or cold, soft or hard, and fresh or salt water.



REVIVE "DEAD." Soviet front-line doctors are reported to have succeeded in restoring life to severely wounded soldiers after all outward signs of death had become evident. Air was forced directly into the lungs through a mask, while blood was injected into an artery near the heart. The work of these doctors, often done under artillery fire, was directed by Dr. V. A. Negovsky and the All-Union Institute of Experimental Medicine.

OF SCIENCE



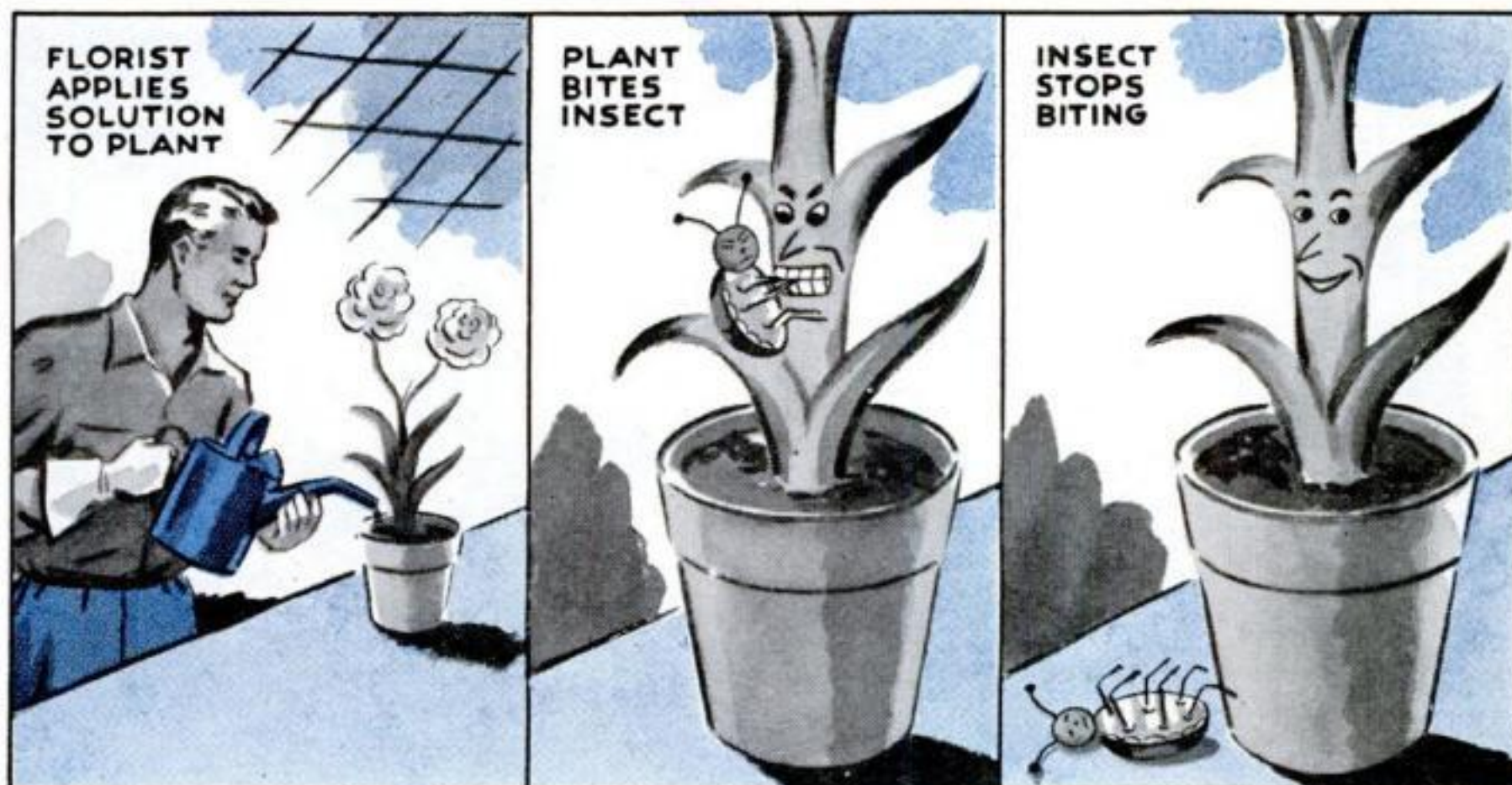
SHARKS KEEP AWAY from downed Army and Navy flyers who are furnished with a new repellent. A small, black cake of the substance, containing chemical salts and a dye, is released in the water when the man-

eaters show up. The inky fluid it produces is so obnoxious to sharks that they give it a wide berth. Coloring of the water shows the flyer how far his zone of safety extends and how strong it is.

WOOD-PULP EXPLOSIVE. After 10 years of research, Western Cartridge Company has developed a process to make smokeless powder out of pulp derived from the southern pine. The pulp seen at the right will make enough powder for the cartridge shown with it.



PLANTS BITE BACK at insect pests after receiving a treatment developed by Dr. W. E. Blauvelt, of the entomology department of Cornell University. A solution of sodium selenate is applied to the soil; taken up by the roots, it accumulates in the sap, foliage, and buds. When an insect takes a bite, it dies. Not applicable to food crops, the method has proved effective in protecting ornamental plants.



How We're Healing the Scars of Battle

Surgeons, engineers, and artists join forces to help wounded GI's return to civilian life as happy, useful members of society.

AS NEVER before in the history of American wars, wounded men are being returned to civilian life with the scars of battle healed—thanks to the surgeon, the engineer, the craftsman, the sculptor, and the artist.

A quarter of a century ago, in the First World War, 46 out of every 100 men who received fractures of the limbs were permanently disabled. Today the figure is only

10 in 100. Injuries that disfigured veterans of World War I for the rest of their lives, that made them marked men among their fellow human beings, today are erased entirely or mended so subtly that no one knows of them except the men themselves and their families.

Arms made of stainless steel and cable replace those lost in combat. Their users can shave, play games, write, smoke, and drive automobiles. Better artificial legs permit a man to walk, dance, and field a fast ball on the baseball diamond. Plastic eyes, ears, noses, and hands defy ready detection. Lost jaws and cheekbones are replaced with bone and cartilage from other parts of the body.

An engineer at a West Coast aircraft plant contrived a new kind of artificial arm. Called "Northrop Control," it substitutes

MODERN MOULAGE CREATES NEW FACES

Supplementing the work of surgeons, American engineers, craftsmen, sculptors, and artists are pooling their talents to create lifelike arms, hands, ears, and noses for GI's maimed in the war. Dr. Stanley D. Tylman (below, center), inventor of a plastic that has a texture similar to skin and a tissue-like flexibility, looks on as Mrs. Nancy Hahn, famous sculptress, puts the finishing touches on an arm.



BEFORE. Born without an ear, as shown, a 17-year-old Canadian boy went to Dr. Tylman for treatment.



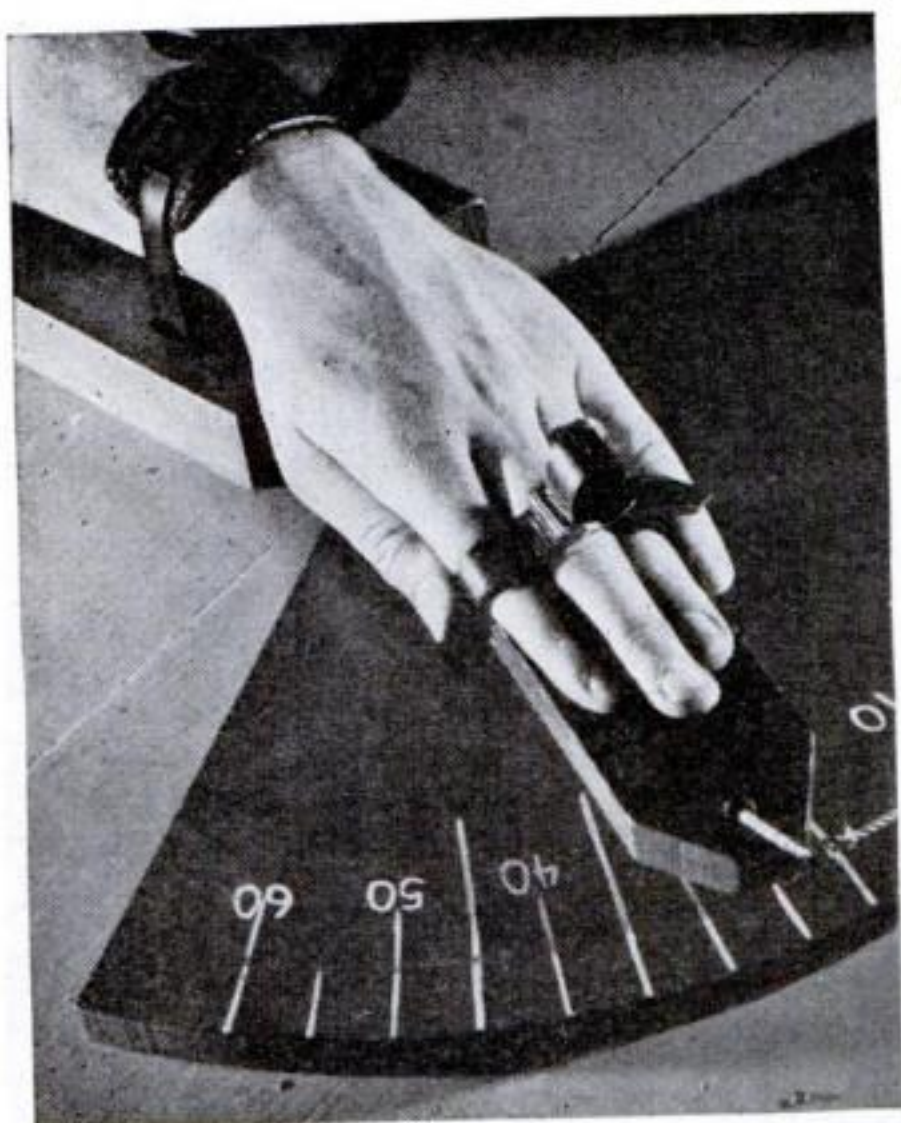
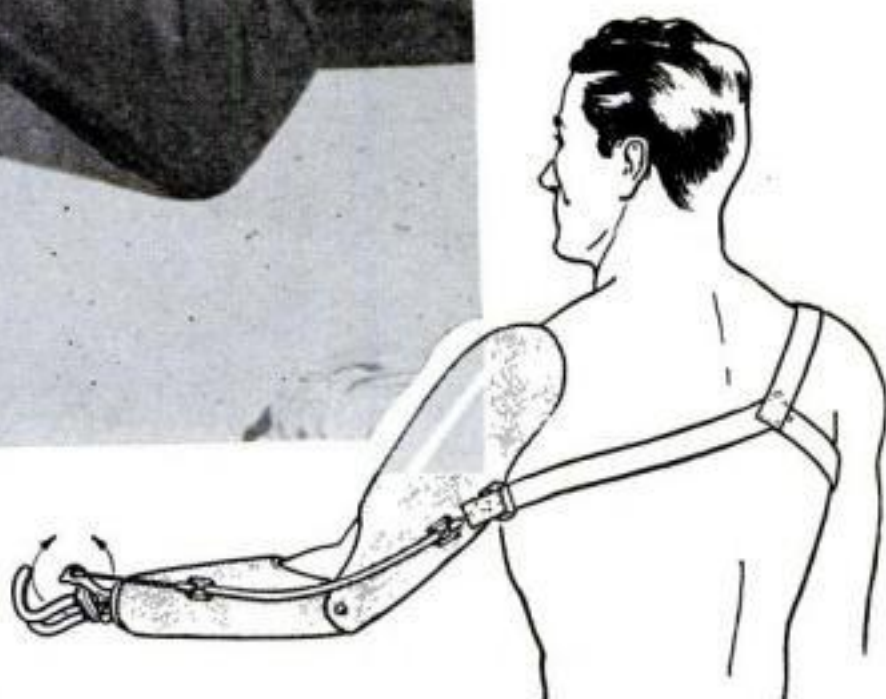
AFTER. Here's the result. He now has a plastic ear, blended to match his skin, that looks normal.



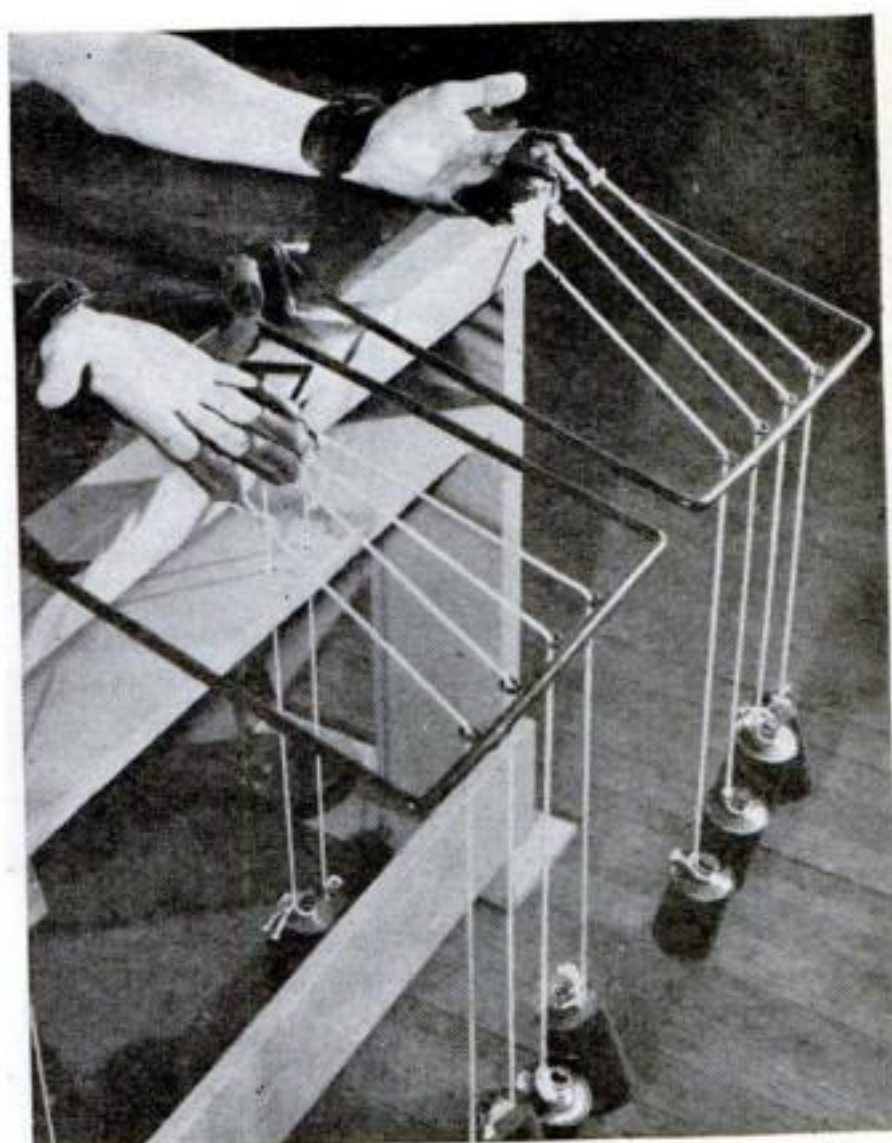


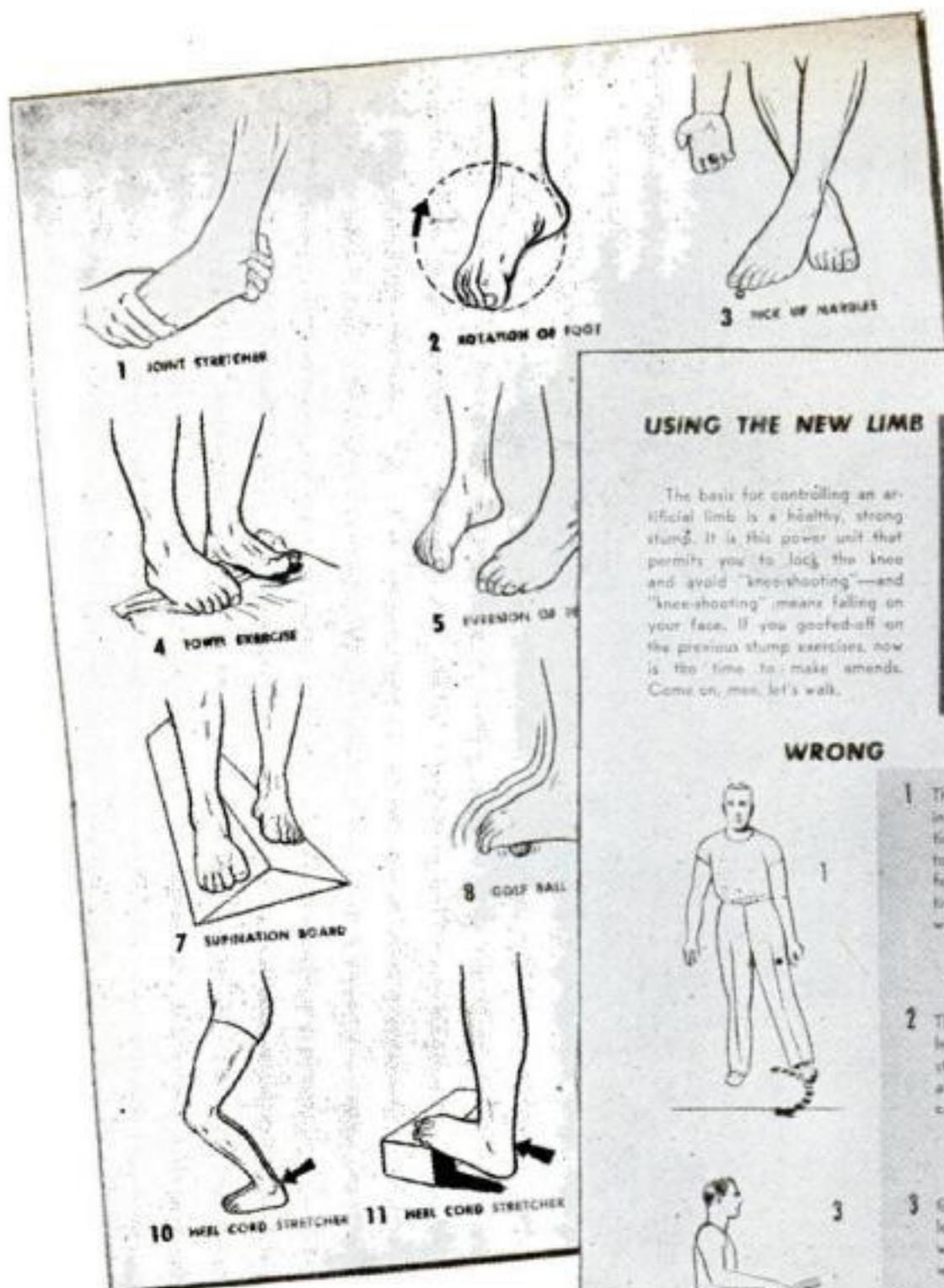
NEW ARMS THAT WORK. Lt. Henry Bass, of Hamlet, N. C., lost his two hands in a dynamite explosion, but now makes almost natural movements, using the "Northrop Control." He is able to write, smoke, eat, and even knot a tie.

This device employs a flexible steel aircraft cable in a flexible steel housing. It transmits 80 percent of the force applied by opposite shoulder.



STRENGTHENING HANDS AND WRISTS. Orthopedic specialists of the AAF Personnel Distribution Command at the Fort Logan (Colo.) Convalescent Hospital prescribe specific programs of exercise on these odd contraptions (above and at right) to restore normal use of joints and muscles.

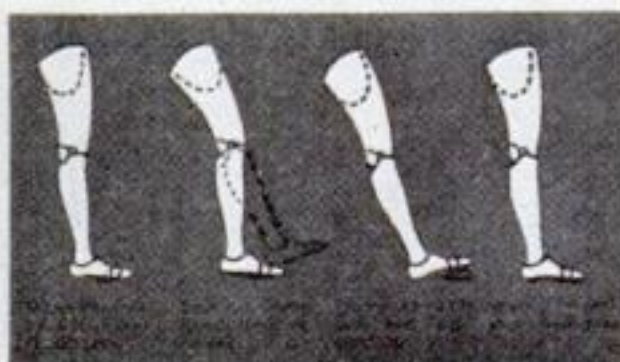




FOOT MUSCLES are strengthened through a whole range of exercises (left). These are designed to bring back the elasticity lost through fractures, frostbite, etc.

USING THE NEW LIMB

The basis for controlling an artificial limb is a healthy, strong stump. It is this power unit that permits you to lock the knee and avoid "knee-shooting"—and "knee-shooting" means falling on your face. If you goofed off on the previous stump exercises, now is the time to make amends. Come on, men, let's walk.



WRONG



1 This is the abduction walk—a rolling gait—and it's wrong. Abduction is a tough habit to overcome, too. Don't raise hip and shoulder for this swings your leg out. Additional exercising of the adductors will help prevent abduction.



2 This is correct. This is normal. The leg does not swing out. It moves straight ahead. Hips and shoulders are level. Don't rely too much on crutches. You don't need them.

3 Going up stairs, place your good leg on the first step. Follow up with the artificial limb. Continue with good leg to the second step.

4 Going down stairs, reverse the procedure. Place artificial limb on lower step. Bring body weight forward to keep limb extended. Move good leg down.

RIGHT



ARTIFICIAL LEG. With determination and patience, plus expert medical care, many GI's have learned to walk, run, and play again with the naturalness that goes with sound legs.

for the leather thongs generally used to actuate the "hook" or grasping mechanism flexible aircraft cable in a flexible stainless-steel housing. A man can do more with it because it transmits four fifths of the force applied to it by the opposite shoulder. Thongs transmit only one fifth.

Lighter, more easily manipulated artificial legs made of fiber are making walking and running so easy for one-legged veterans that one of the Army Air Forces' prize cases, who had despaired of ever walking again, now runs 70 yards in 14 seconds. That would be pretty good for a man with two good legs.

An AAF pilot shot down over Berlin had to have a leg amputated. No sooner had he returned to the United States and been fitted with an artificial leg than he insisted on going dancing. He dances well. What is more, he is a candidate for a berth with a major-league baseball team.

Improvements have been made in the steel plates and screws used to join broken

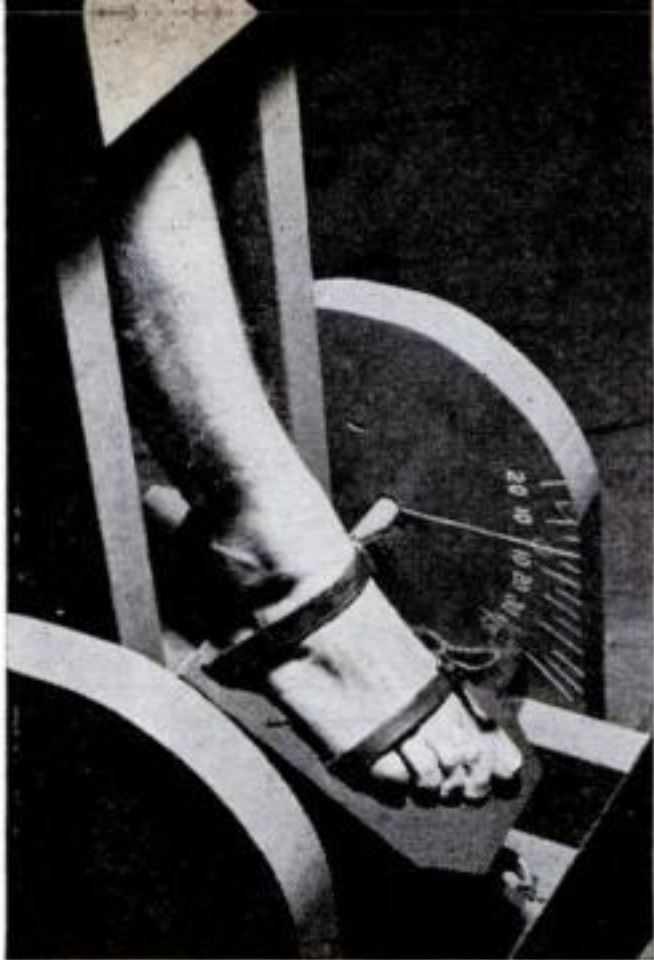
bones until they can knit. Springs, steel bars, and wire anchored to the bones of the head speed the recovery of men with broken or rebuilt jaws.

Artificial eyes are made from a water-clear plastic that can be tinted to duplicate the appearance of the natural eye. They are lighter and better-looking—and they won't break if they are dropped accidentally.

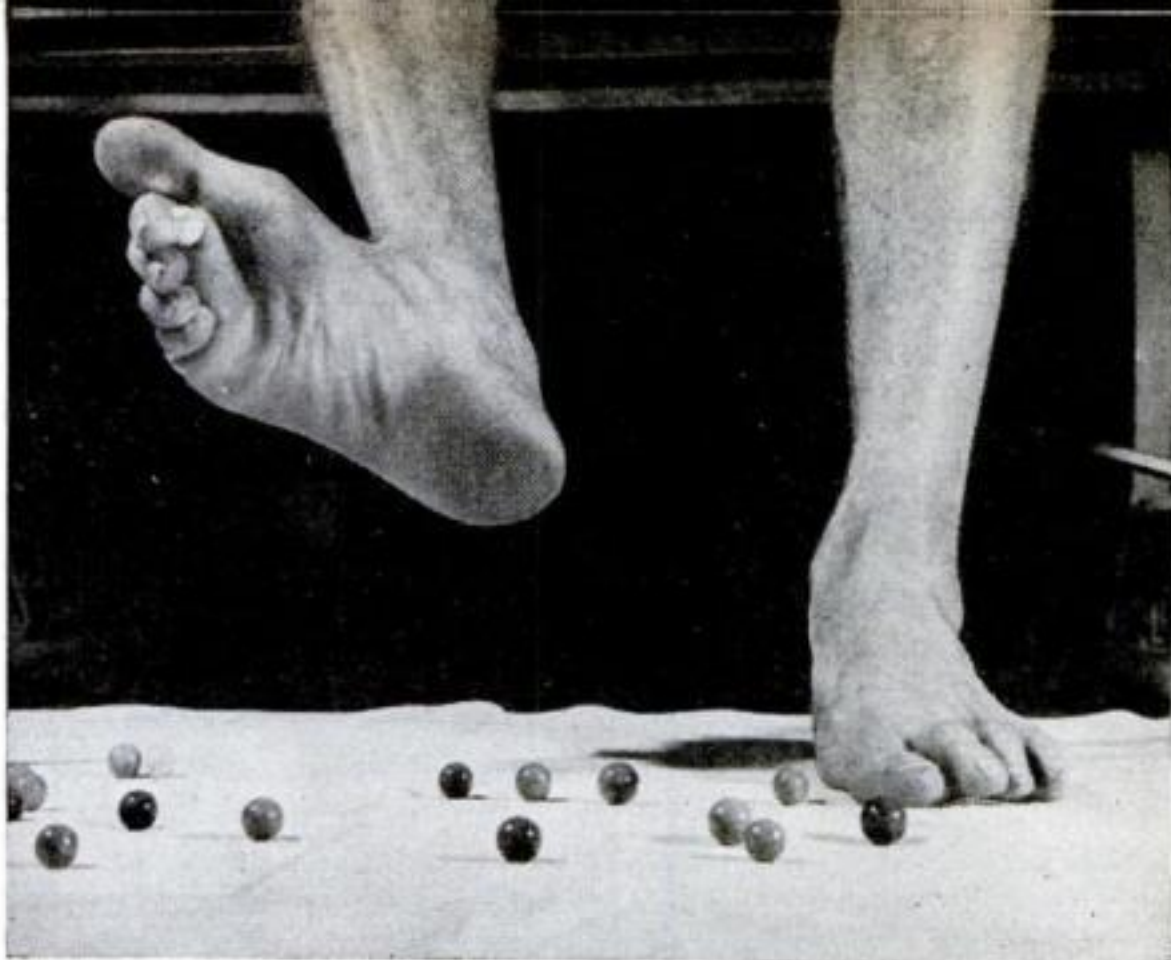
Plastic splints, in some instances, are replacing those made of wood and metal. They are transparent and more sanitary.

Much of the success in body repair is due to better surgery. Portions of the face that have been lost through gunfire are rebuilt with cartilage, bone, and skin from other parts of the body, or with stainless-steel plates.

A soldier at one of the Army's general hospitals, who lost the entire lower part of his face on the Volturno River in Italy, is going to be presentable again with bone borrowed from his ribs. The doctors used part of the bone in a preliminary operation



ANKLE EXERCISE is provided by this device. The markings show the improvement made by a patient and encourage him.



PICKING UP MARBLES with the toes strengthens the muscles and ligaments that work the joints of the foot. This and other simple exercises are putting our wounded back on their feet. Patients who might have been crippled for life have made remarkable recoveries.

to reconstruct the jaw. The rest they "stored" under the skin in the fatty tissue of his abdomen. That saved the painful operation of reopening his chest wall. Soon they will take the bone out of storage and finish the job of reconstructing his face. Skin will be obtained from his arms.

A "skin flap," consisting of whole skin, is one of the commonest devices used to mend wounds from gunshot and shrapnel, where a good deal of tissue is destroyed. Living, healthy tissue is bound to the area and the flap secured to it. The portion supplying the skin is called the "donor" area. The skin is cut on three sides. The fourth side, left intact, insures a circulation of blood. The injured member is bound to the area and the flap secured to it.

In a few weeks the fourth side is cut and the graft completed. The "donor" area meantime is growing new skin.

Sometimes "split skin," the extreme outer layer, is removed entirely from

a "donor" area and laid on the injured portion. The body will replace "split skin" in a couple of weeks, but it takes months to regrow whole skin.

Noses are rebuilt by shaping a tubular "flap" with skin from a patient's arm. When the flap is cut free, cartilage from the chest is used to form a bridge. Then canals are cut to form nostrils.

Even eyelids can be rebuilt by the skin-flap method. Ears are rebuilt or replaced with cartilage and with skin from immediately behind the ear.

In the rebuilding and shape-restoring processes, artists and sculptors are called in to enable a soldier to resume his place in society with confidence. With crayon and

SPORTS competition is strong among our war veterans, even when they have lost arms and legs. These fellows surprise themselves and onlookers with their agility. They play as hard and have as much fun as boys on a corner lot. Some of them expect to go back into professional sports.



plaster they supply the doctor with a pattern of what the patient should look like when the job is done. Often they sketch in the operating room while the surgery is going on.

A piece of transplanted skin may differ in color from that surrounding it. Then the tattooist steps in to give it the proper "pigmentation."

Lifelike and durable members of the body can be built out of plastic substances when it is impossible to use natural ones. Noses, ears, fingertips, and even whole hands are being made for the maimed. One of the leaders in this field of reconstruction is Dr. Stanley D. Tylman, a University of Illinois Dental College professor. A plastic he has developed has a texture similar to that of skin, a tissuelike flexibility, and a lifelike translucency. It can be colored permanently to blend with the coloring of the individual.

What is developing into a new philosophy of convalescence—based on the conviction that the spirit of the man has most to do with the mending of the body—is an integral part of the rehabilitation system. In scores of hospitals and rest camps soldiers and sailors are being told in dozens of subtle ways, first, that they are going to get well; second, that they are going to become useful members of peacetime society.

Convalescence starts "the moment a man loses his temperature." He is encouraged to play golf, go horseback riding, boating, and bicycling. There is a purpose behind that. A man is inclined to "favor" an injured muscle. A muscle that isn't used will atrophy, or waste away.

The Army discovered that little pianos could be made out of scrap material. Since piano playing exercises the muscles of injured hands, the construction of miniature pianos—some of the parts, such as wire, came from damaged airplanes—became a

number one project for the rehabilitation camps.

A soldier with a bad arm was put to digging post holes against his will. It hurt to use that arm. Gradually the doctors nudged him into it. The arm began to return to condition so rapidly that when the soldier got through with his post holes he asked if he couldn't chop down an acre of trees to clear some land for farming. He did. When he finished, the arm was almost as good as new.

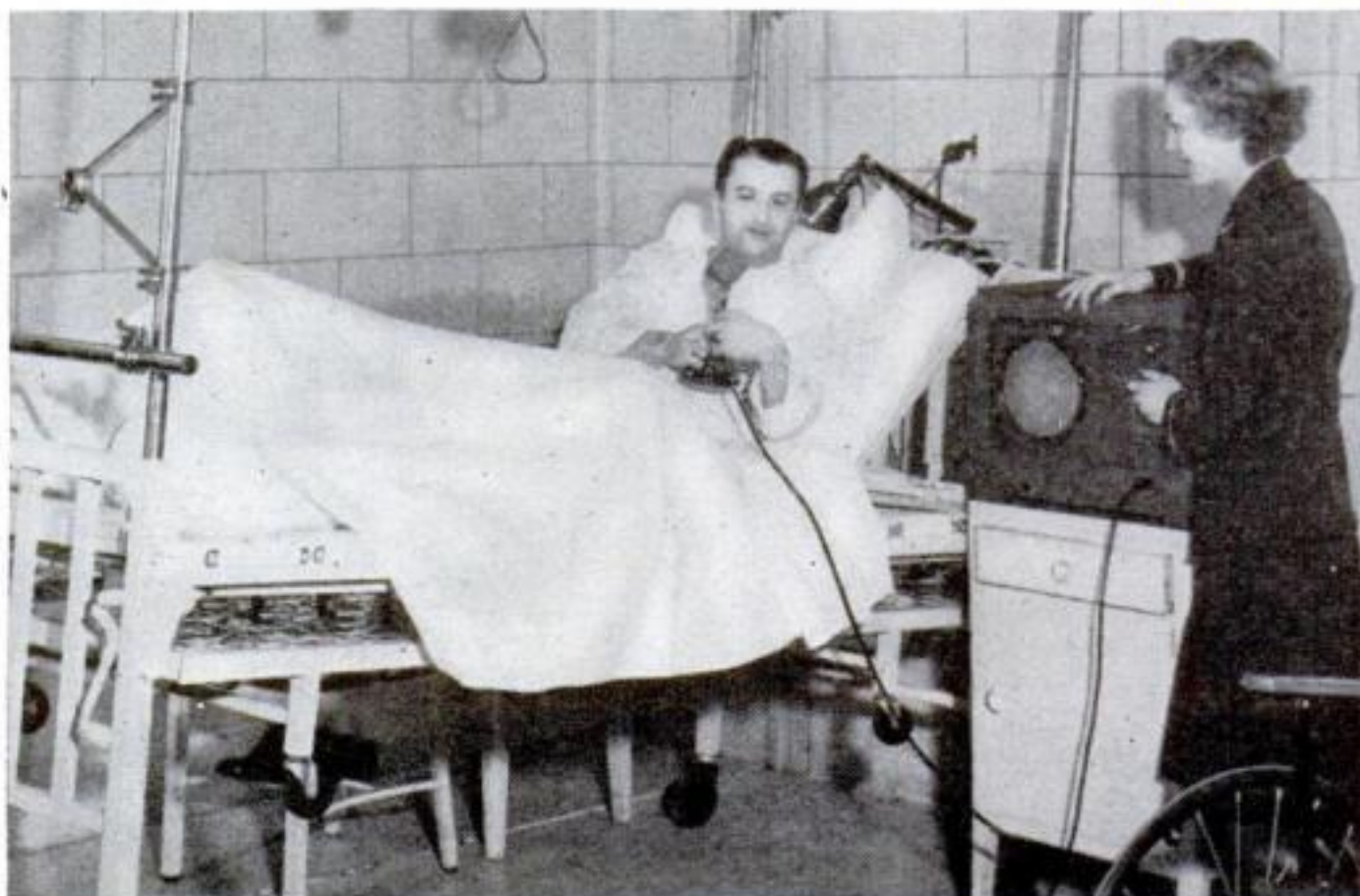
Soldiers on the mend can enter classes in any one of 800 subjects they want to learn to fit them for earning their living when they are discharged. Whole machine shops, shops in canvas craft and other pursuits, are built in the rehabilitation centers. A by-product of all this is occupation of a man's time so he won't keep worrying about himself.

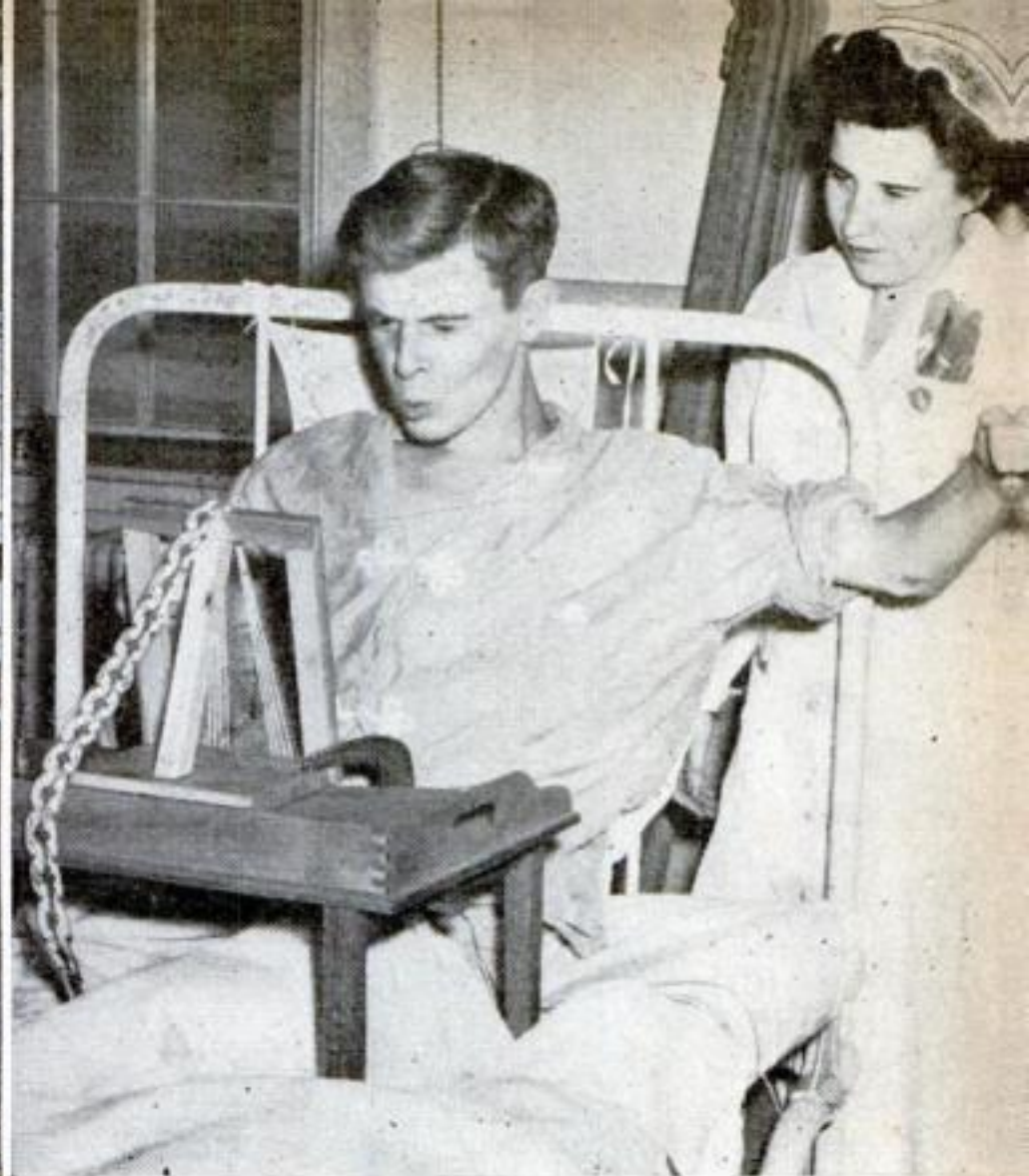
The system pays off in self-confidence and in the confidence of the service man in his country. One soldier in a rehabilitation camp disappeared one night and turned up the next day with his baby, which his wife had deserted. He was confident that the Army would take care of the child. It did, too.

The blind are being taught trades. Two sightless soldiers, sent to a manufacturing plant on an experimental basis, did so well in competition with other workers that the management asked for more blind men. Industry, it argued, has its part to play in occupational rehabilitation.

The incidence of the wounds on different parts of the body in this war is about the same as in other wars. More than 70 percent of them are in the arms and legs. About 10 percent involve the head, face, and neck, and about 18 percent the trunk of the body. The figures correspond roughly to the amount *(Continued on page 236)*

SPEECH impediments and enunciation defects caused by head injuries and various other wounds are being corrected in Army and Navy hospitals by use of the Mirrophone. This device records a patient's voice on a magnetic tape, then plays it back to him.





OCCUPATIONAL THERAPY REBUILDS MORALE AND HEALTH OF WOUNDED

Manual training aids are employed in many of the 800 subjects taught in War and Navy Department rehabilitation hospitals. The soldier at the left is operating a bicycle jig saw to exercise his knees. The bed patient, injured in both arm and leg, strengthens his shoulder, elbow, and fingers by knotting a colorful belt. Approximately 75 percent of the men wounded in battle become so skilled in operating the various devices used to remedy injured nerves, paralyzed muscles, and other disabilities, that they are able to teach buddies.

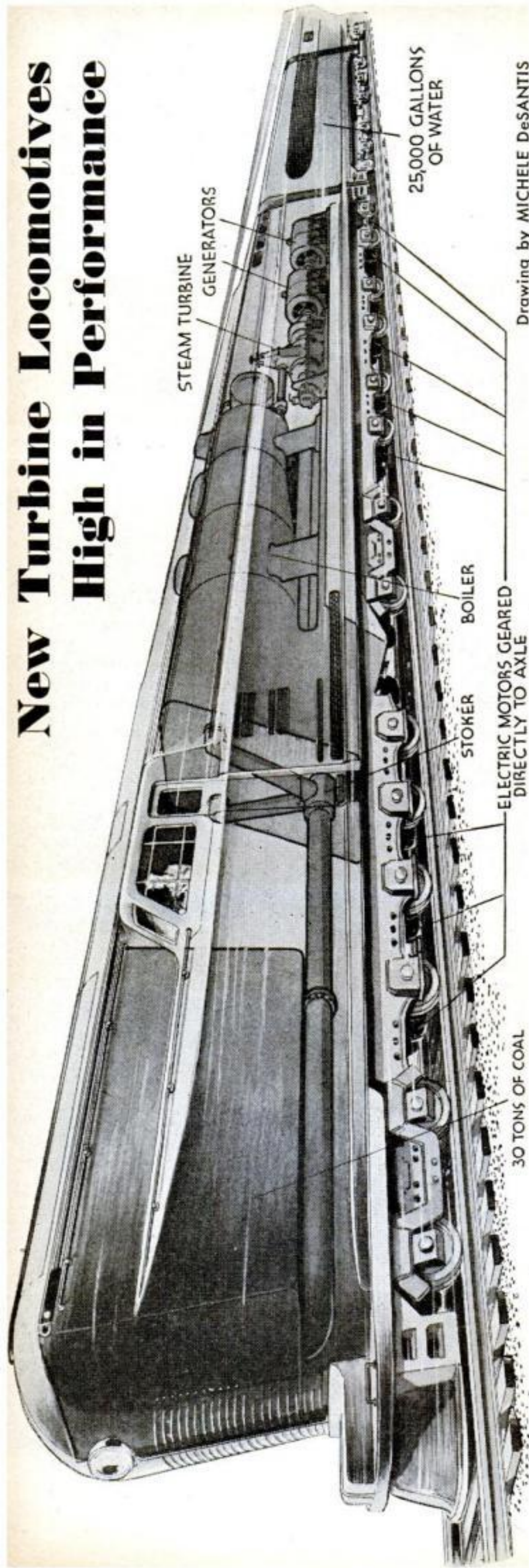
SPECIAL TOOLS ENABLE THE BLIND TO WORK IN GARDENS

The blind can now plant, cultivate, and harvest their own gardens without assistance, by means of tools designed by Hugh Findlay, professor of landscape architecture at Columbia University. With taut wires to mark the rows and guide the implements, blind gardeners are able to hoe, rake, plant, weed, and spade sizable plots of flowers or vegetables. The weeder below has a steel bar attachment that can be adjusted, permitting the implement to loosen the soil close to the plants or out toward the middle of the row. A light rake, a hoe, and a weed cutter are also made with fittings that hook to the wire.



The tool, attached to the guide wire, cannot go off course, and blind gardener also is guided by the wire as he moves along.

New Turbine Locomotives High in Performance



Drawing by MICHELE DeSANTIS

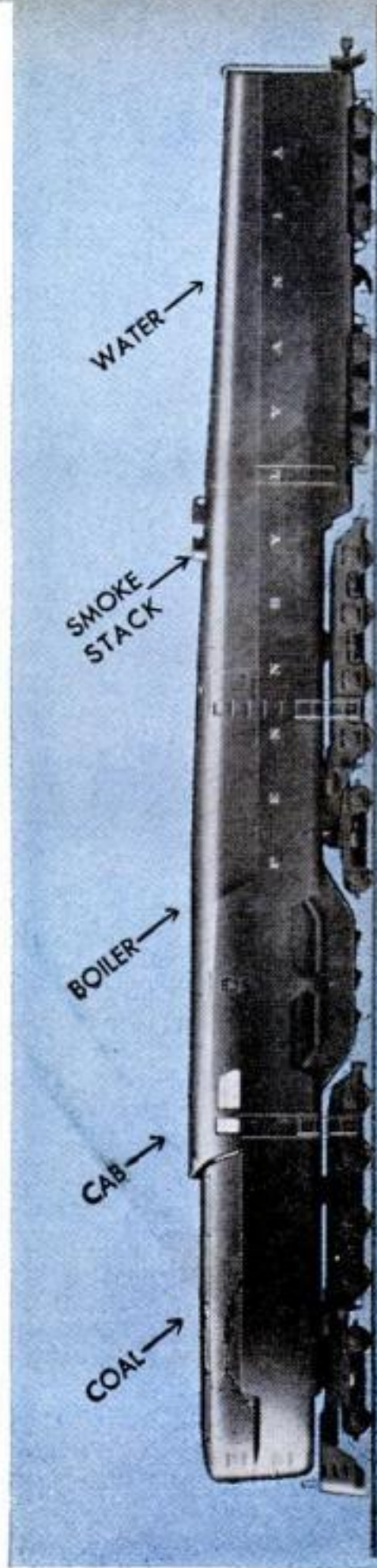
WHIRLING turbine blades, instead of flashing pistons, will drive powerful streamline locomotives to drag the crack steam-powered trains of tomorrow. Two leaders of this new trend in American railroading are shown on this page.

Most revolutionary is the turbo-electric engine above, designed for the Chesapeake and Ohio Railway. Steam from its coal-fired boiler will operate the turbine to deliver 6,000 horsepower to a pair of generators. These will feed 4,000 kilowatts of electricity to the motors that spin the driving wheels for speeds above 100 miles an hour under full load.

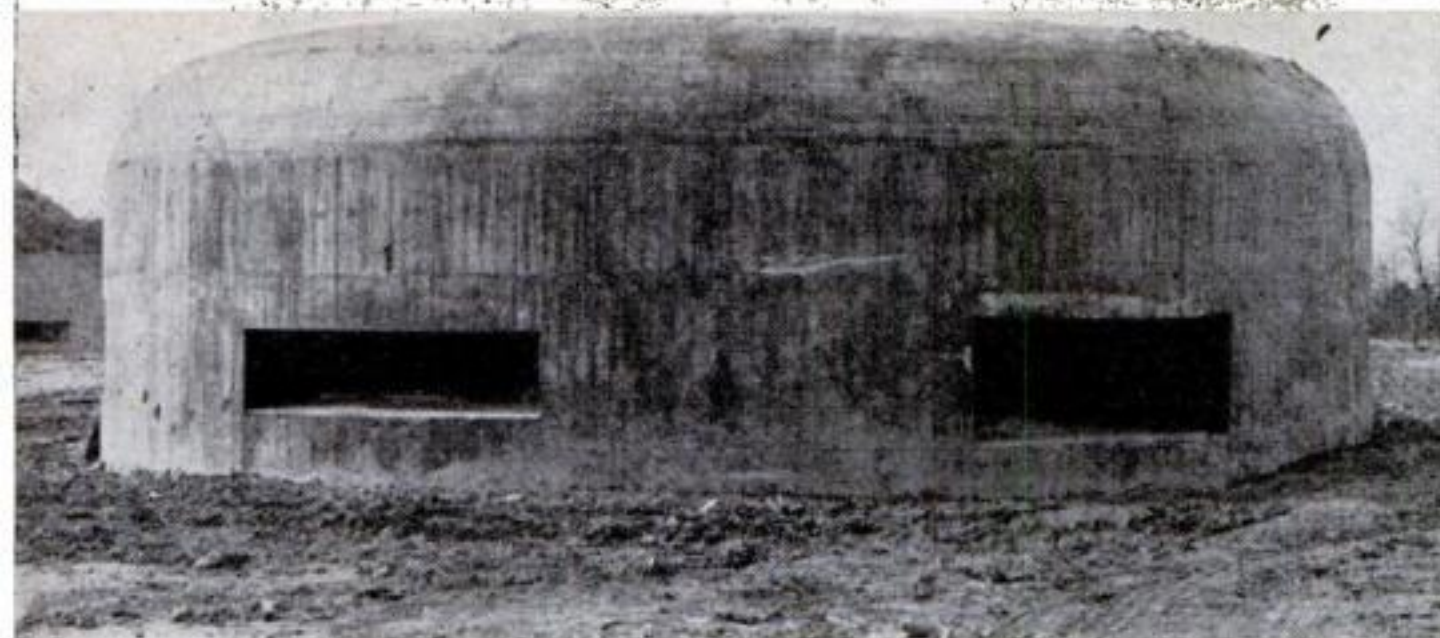
Coal is carried in the head end, while the tender is given over entirely to water. Over-all length, including the tender, is

more than 137 feet; height is 15½ feet. Three of the giants will be built for the C. & O. by the Baldwin Locomotive Works, with Westinghouse furnishing the electrical equipment. These will be the first steam turbo-electric locomotives to hit the rails in the U. S.

Similar in arrangement, except that the turbine will be geared directly to the driving wheels, is the "Triplex" (below), designed for the Pennsylvania Railroad. Swiveling trucks will enable it to take any curve that a standard passenger coach can negotiate.



BEFORE



The Army's Fortbuster was tested on this copy of a Nazi pillbox. The concrete walls and roof, reinforced by steel rods, could withstand the impact of a locomotive going 100 m.p.h.

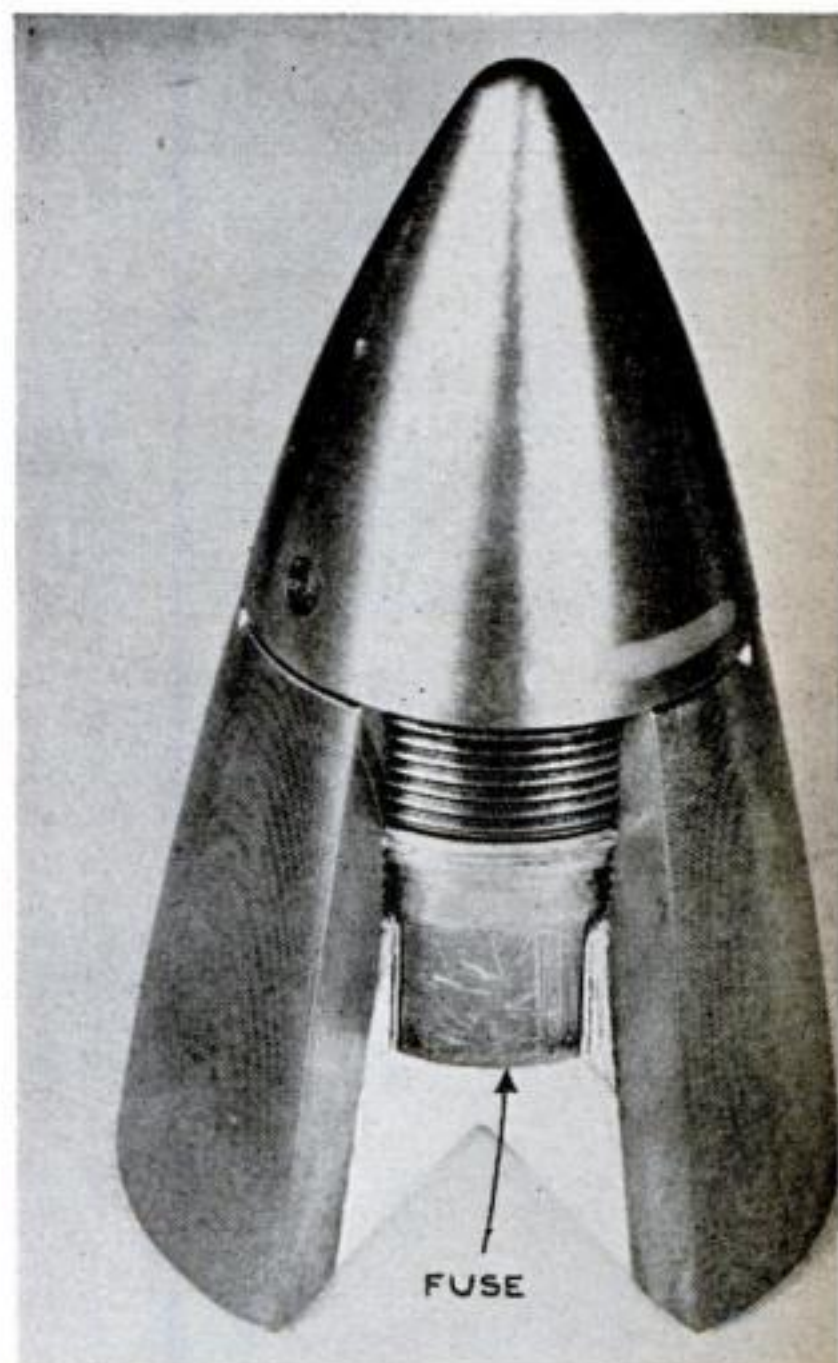


Fortbuster

A LITTLE fuse—no bigger than a hen's egg—crumbled the concrete of the German West Wall and the Siegfried Line, and will do smashing duty wherever there is tough concrete or similar resistance on the road to Tokyo. It's the Army's Fortbuster.

Designed and developed at Aberdeen Proving Ground, Maryland, the device can turn an ordinary shell into a missile capable of blasting its way through concrete thicker than the height of a man. Screwed into the nose of any standard shell (75-mm. to 240-mm.) except the 120-mm., the fuse keeps the shell from collapsing upon impact and drills a path through for the explosive-filled casing to follow, explode, and demolish the concrete.

Ordnance engineers built replicas of German pillboxes that were stronger than the specifications sent in by our agents in Europe. Their concrete walls, reinforced by crisscrossed steel rods, had a compressive strength of almost 7,000 pounds per square inch. The Fortbuster reduced them to heaps of rubble.



This egg-size fuse—screwed directly into the nose of any artillery shell from a 75-mm. to a 240-mm., except the 120-mm.—drives a shell through massive concrete walls to explode inside of a fortification.

AFTER



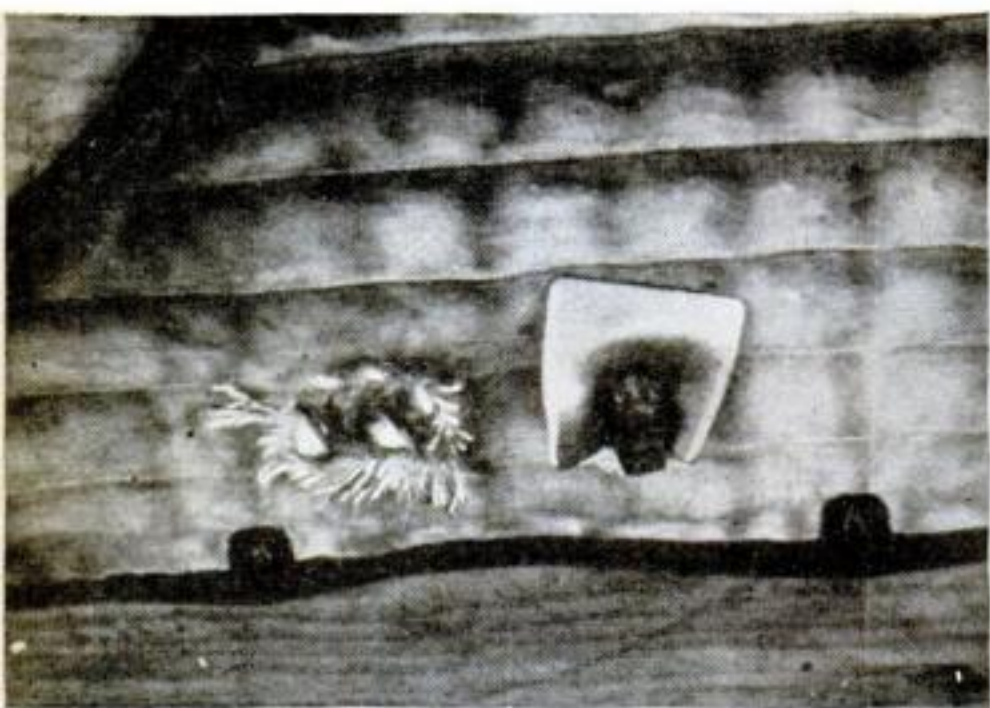
A heap of rubble and twisted steel is all that is left of the neat pillbox shown at top of the page after it got the Fortbuster treatment. The little fuse, designed to crumble German pillboxes, is now helping to smash resistance on the road to Tokyo.



This apron of a B-17 bombardier's "flak suit" was pierced by a shell fragment, but the flyer is convinced the steel armor saved him from serious injury.



A .303 machine-gun bullet, fired from close up during a head-on attack by enemy fighters, went through this flak vest. The wearer was killed. The armor protects against such bullets down to a range of 650 yards. A piece of flak ripped through four plates of the steel apron below, but only bruised the flyer.



What's the Score on Flak Armor?

THE steel-and-canvas "flak jackets" (P.S.M., Mar. '44, p. 54) that protect our bomber crewmen from enemy bullets and shell fragments have caused a reduction of 58 percent in the number of men wounded and have reduced the number of wounds sustained by 60 percent. These figures are based on a study made by Brig. Gen. Malcolm C. Grow, USA, and Lt. Col. Robert E. Lyons, MC, pioneers in the development of body armor for combat flyers. The investigators also report that the steel protection has boosted the morale of air combat crewmen since it was introduced as regular flight equipment in November 1943.

A study of the location of wounds sustained indicates a reduction of 14 percent in wounds of the head and neck, 58 percent in wounds of the thorax, and 36 percent in wounds of the abdomen. A comparison of the number of flyers struck while wearing armor with those struck while not wearing the protection shows a reduction of fatality of thoracic wounds from 36 to eight percent, and of abdominal wounds from 39 to seven percent. Body armor, it was found, prevents approximately 74 percent of wounds in all covered areas.

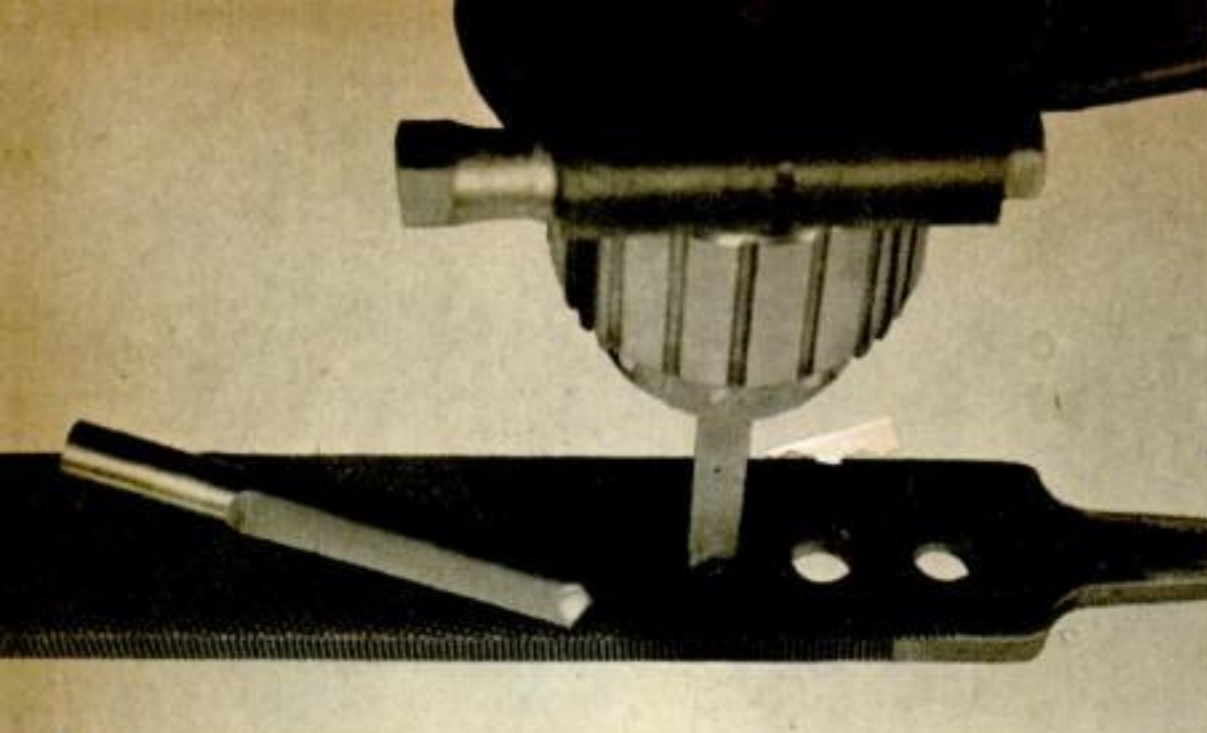
The jackets and aprons, made of manganese steel plates one millimeter thick, resist low-velocity missiles and also .303 machine-gun bullets down to a range of 650 yards.

Your Pin-Up

P-38 LIGHTNING FIGHTER. One of our oldest basic fighter designs, this Lockheed killer is still spreading destruction among our enemies. Like the Nazis before them, the Japs have learned to dread attacks by the deadly "fork-tailed devil."



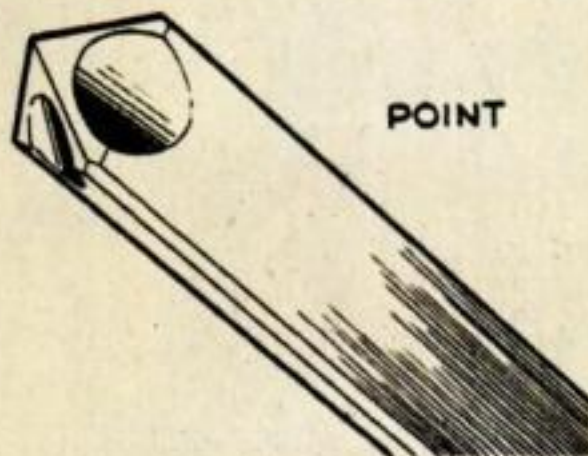
new Tools



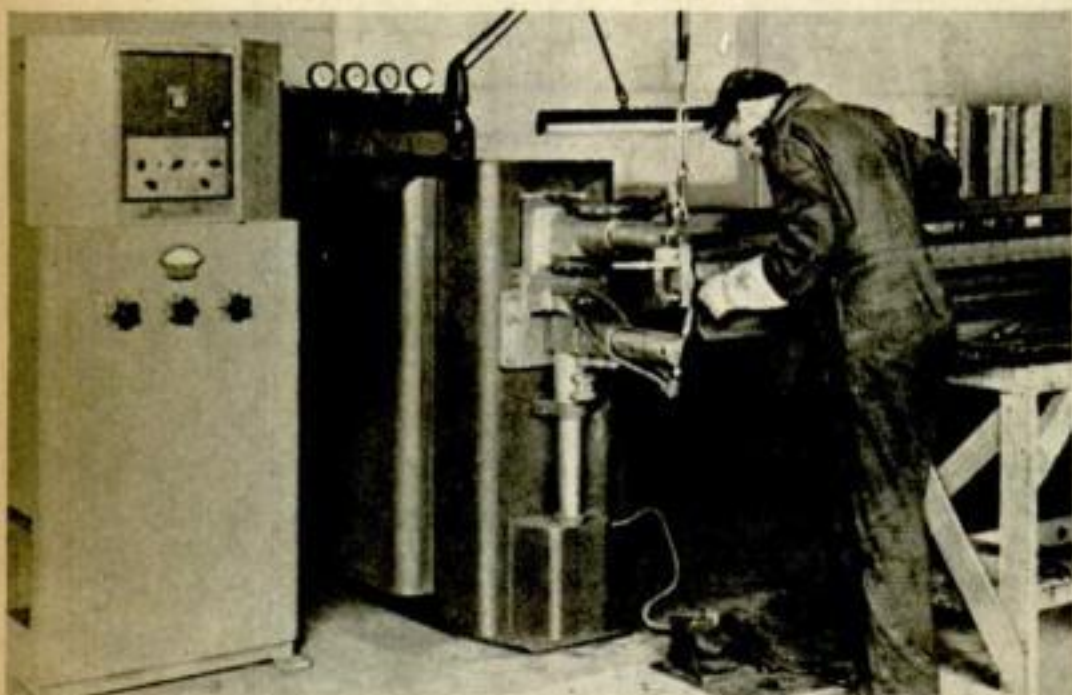
BORING THROUGH HARDENED STEEL is now done with a triangular-shaped drill provided with chip-clearance grooves at its point. No annealing is necessary with the Hardsteel drill, for it works on the principle of annealing the work beneath the drill point by frictional heat, then wiping out the softened chips. The hole itself has a burnished surface. No special tools or fixtures are required. Manufacturer is the Black Drill Co., Cleveland, Ohio.



END
VIEW

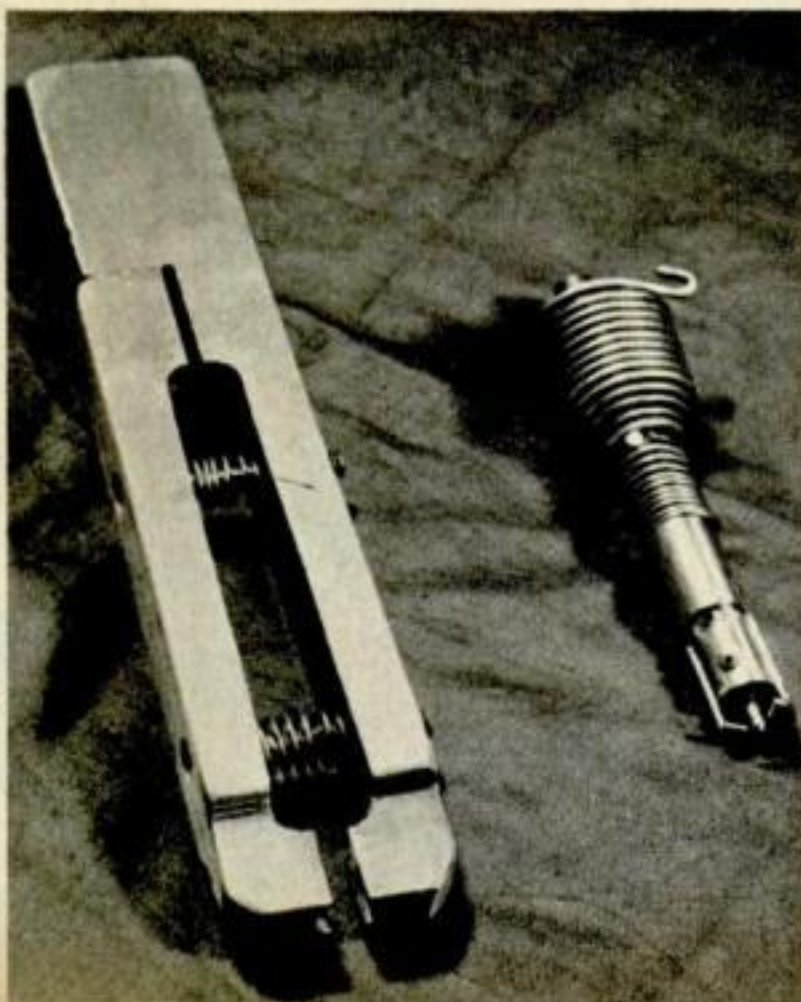
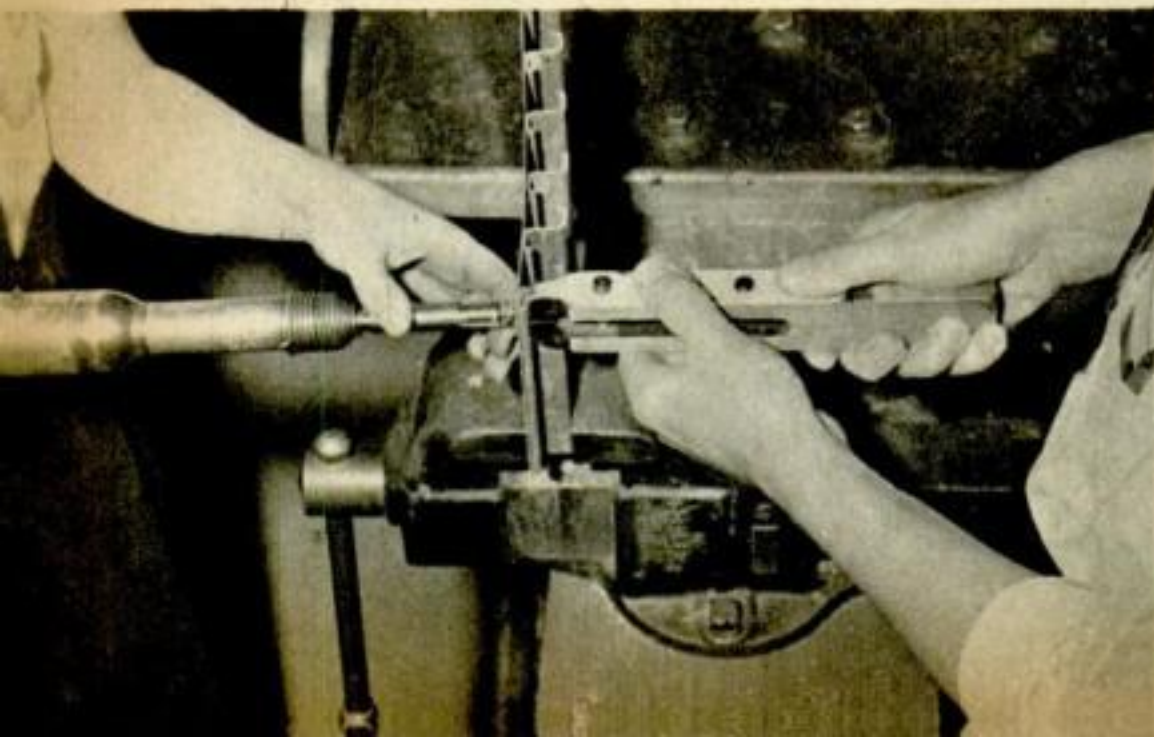


POINT



STORAGE-BATTERY WELDER, made by the Progressive Welder Co., Detroit, Mich., may be used on any kind of material capable of being resistance-welded, including aluminum, brass, stainless steel, and alloy and carbon steels. The picture (left) shows a portable battery welder that in 20 hours made 29,000 spot welds on two $\frac{1}{8}$ -in. sections of structural steel. This welder needs only 12 battery cells, kept at peak by a charger operating automatically from a 220-volt AC line. Over-all cost of battery welders is said to be lower than for other types, and little maintenance is required.

RIVET REMOVER uses a conventional rivet gun and a new type of bucking bar. Shown below is the combination at work. Blows from the gun are applied to the manufactured rivet head while the bucking bar pulls at the driven head. The device was developed by H. D. Rocheville, foreman for Consolidated Vultee.



Holds and How to Break Them

YOU may be held up by a thug. When that happens, you will be glad you studied these pictures. They show how you can out-smart and often overcome a bruiser who

makes a surprise attack. It's science and quick thinking pitted against brute force, and the advantage is likely to be with the little fellow who knows how to meet attack.



STRANGLE HOLD. 1. A vise-like grip on your throat, with thumbs against your jugular vein, can be broken if you . . .



2. Clasp your hands and bend forward quickly, then very suddenly thrust the folded hands upward between your assailant's arms and spread your own.



3. The expanding wedge formed by your arms breaks the assailant's strangle hold, and you are ready for him.



BEAR HUG. 1. Attack is met by similar but rougher tactics. Put one foot back, drop whatever you're carrying, fold hands, and...



2. Sock! As you bring up your double fist, you clip the big palooka on the end of his underslung jaw. Bend the knees, and straighten them as you hit.



3. Then, before he gets over the chin wallop, clinch an arm around his back and jab your free hand under his nose.



MUGGING. 1. This is a strangle hold from behind. Mugger hooks his right arm over your throat, and locks it with his left hand.



2. Turn your head to relieve throat pressure, move right, grab attacker's right sleeve at elbow, place left foot back of his right one; lean forward . . .



3. Having yanked the mugger to your left hip, throw him for a loss by tilting your body and pulling his sleeve.

THE WAR ON FIRE

ARMY AND NAVY SET AN EXAMPLE FOR THE HOME FRONT WITH NEW METHODS AND MATERIALS FOR PROTECTING LIVES AND PROPERTY

By DEVON FRANCIS

THE Army and the Navy have discovered the means of keeping tens of millions of dollars' worth of military equipment from going up in the smoke of wartime fires. On war fronts from Fairbanks to Accra and from Kwajalein to Chengtu, flames are being quenched almost as they start.

The aircraft carriers *Lexington* and *Wasp* probably could have been saved from the fire that destroyed them if the Navy's ships had been equipped in 1942 as they are equipped now.

No longer is an airplane crew considered as good as lost if the plane comes in wrapped in flames. Men are being gotten out of burning planes in a few seconds.

A large part of the reason for all this is that the armed services have found out how to use water.

For thousands of years the most plentiful liquid on earth has been used to kill fire. Only in the last decade have fire fighters discovered what water really can do. Only since the war began have the techniques of using water been perfected.

Two things so simple that their principles can be demonstrated in your own household are opening up a whole new world of applications in fire fighting.

One is water fog. The other is foam. The basic ingredient of each is plain water, and it can be salt water or fresh water.

Alone, fog and foam won't put out all fires, but they will go a long way toward it. In combination with inert gases they can bring

to a new low the frequency with which the hysterical shriek of the fire engine is heard on the streets of American cities.

Water fog is mechanically the same thing that squirts from your bathroom atomizer. Actually, it is an extremely fine spray, much finer than the spray you get from your garden hose.

Foam is substantially the same thing that a housewife makes when she whips cream. Soybeans, fish scales, and iron salts play a part in its manufacture.

The third of the principal fire-fighting substances is carbon dioxide, the same thing that makes bubbles come out of your soft drink at the soda fountain, the same thing that you exhale when you breathe.

It is not our intention here to detract from the credit that must go to carbon dioxide as an extinguishing agent. A good fire fighter for many years, it remains indispensable. It is used often where fog and foam cannot be. Fog and foam, and their applications, are newer.

Of the three things, fog has become the favorite of the military fire-fighting crews. Finding the reason why leads into the question of what fire is.

Burning occurs when there is a *rapid* oxidation of any combustible material. Most substances under prolonged exposure to the air will oxidize to some degree. That is, they will unite with oxygen. Iron is a common example. That red stuff on a bar of iron exposed to the elements is iron oxide. Immersed in pure oxygen and ignited, iron will burn with a flame, much

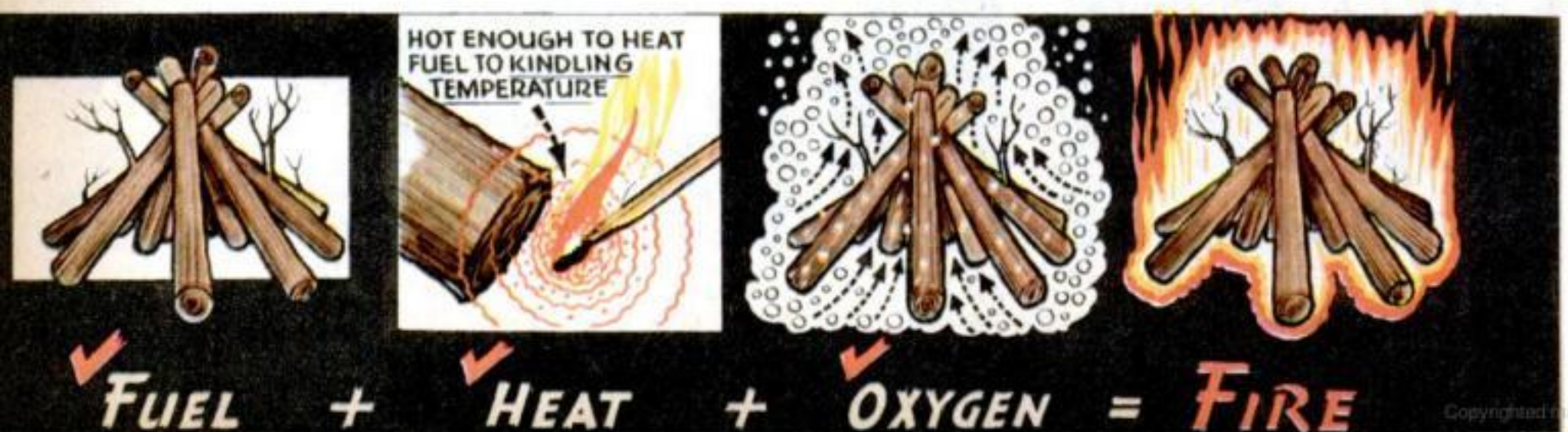
THE ANATOMY OF FIRE

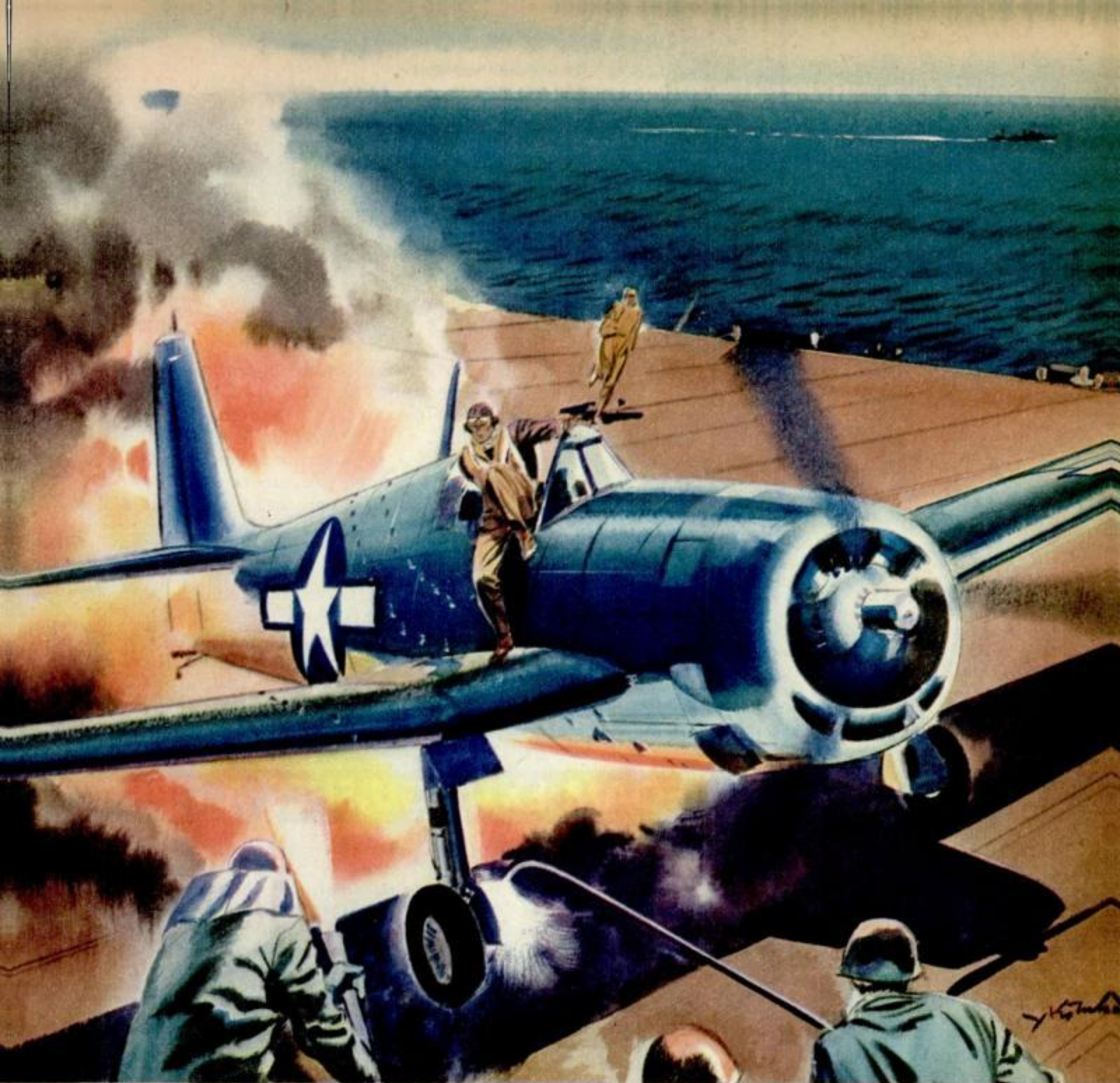
Fuel is the first ingredient needed to make fire. Wood, textiles, and flammable liquids are fuels.

A heat generator, artificial or natural, warms up the fuel to its ignition point, driving off vapors.

Then the vapors combine with the oxygen in the atmosphere, the third factor, and flame is created.

The flame generates more vapors from the fuel, and the fire continues until one factor is eliminated.





The armed services in the last few years have devised and adopted many improved methods of combatting fires that far outstrip home-front efforts. The Navy's record for putting out airplane fires on the decks of its carriers and for smothering flames touched off by enemy bombs and torpedoes is a shining example.

HOW TO PUT OUT A FIRE

101

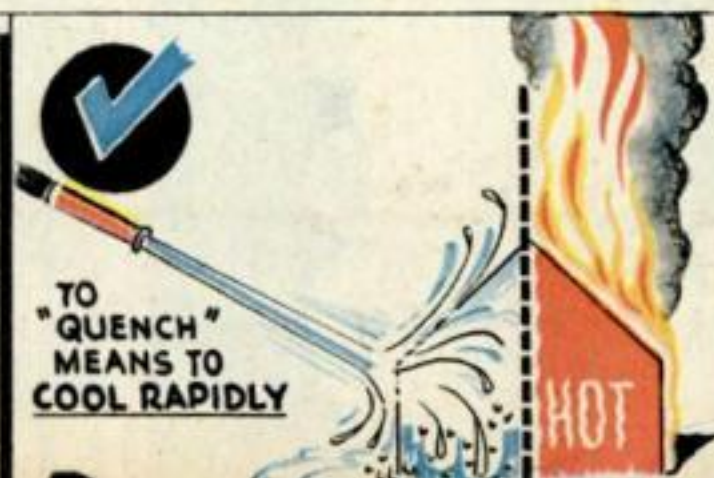
There are four ways to extinguish a fire. One is by removing the fuel. An example is seen below. This method usually is not practical.

The second way is by cooling, and one of the best agents is water. This cools the fuel below its ignition point faster than the flames can heat it, quenching the fire.

A third method is by smothering. Without sufficient oxygen, combustion cannot take place, and shutting it out kills fire.



REMOVING FUEL



COOLING



SMOTHERING



SNIPPING OFF A FLAME. The fourth way of putting out a fire is by separating the burning fuel from its flame. This is demonstrated by a technician for the Underwriters' Laboratories, Inc., who uses a knife to cut the flame of alcohol burning in a can. Another way is to use the force of air, as in blowing out a match. The flame is blown away so that it cannot form combustible vapors.

as wood will. That is rapid, as against gradual, oxidation.

All a combustible substance needs in order to burn is ignition temperature and the presence of oxygen. Even your skin must have its temperature raised before it will scorch. Hold an ice cube between your thumb and forefinger for ten seconds and you can pick up the lighted end of a cigarette without damage.

Everything burnable has an ignition temperature. That for ordinary gasoline, for instance, is 495 degrees Fahrenheit. That for linseed oil is 650 degrees. Once the burning has started, it will go on until the substance is consumed or one of four other conditions is brought about.

Most fire fighting is based on either cooling the burning material below the ignition temperatures, or robbing it of oxygen, or both. There are two other ways of putting out a fire—removing the fuel, and separating the flame from the burning material.

Water fog has become so valuable in quenching fires because water will



FOAM EXTINGUISHES A FIRE

The armed services perfected the use of foam in quenching fire. This medium, which is a mass of gas bubbles, or air bubbles stabilized by vegetable or animal protein, is completely harmless. It could even be eaten without harm.

Foam is tough and stable, too, although it is 94 percent water. In fact, it is of such a consistency that it can be picked up by the handful, and shrinkage is only about 10 percent in 15 minutes. Heat even toughens some foam.

This fire-smothering agent is created mechanically in a special nozzle by combining water under pressure with a binding substance. One stabilizer, made by the National Foam System, has a soybean base, and a five-gallon can of it produces 500 to 600 gallons of foam. A chemical foam may be made by generating carbon dioxide gas. However, the equipment needed is too cumbersome for use aboard ships.



absorb heat much more readily—that is, it will lower the temperature of whatever is burning—when it is broken up into droplets.

Water will absorb heat four times faster than air. Scientists know exactly how much heat it takes to convert water into steam. If you have a pound of water in your teakettle on the stove at room temperature, you have to apply 1,010 pieces of heat measured in what is known as "British thermal units" to burn the kettle dry. Forty B.T.U. will raise the temperature of the water to the boiling point but the change from liquid to steam requires 970 B.T.U.

That accounts for water's tremendous cooling effect.

The use of water fog permits the only departure from the rule, *DON'T PUT WATER ON BURNING GASOLINE*. Ordinarily, water only spreads a gasoline fire. Water is heavier than gasoline, and the burning fuel floats around on it, igniting other substances.

But that doesn't happen with fog. Fog is converted into steam as fast as it hits the flames. Under ordinary conditions that will put out the fire or so lower the gasoline's temperature that foam or carbon dioxide gas will quench it.

Foam, which is 94 percent water, is little more than fog turned inside out. Fog is water drop-

BY SMOTHERING IT

For best results in killing a fire with foam, as shown in the pictures at the right, a blanket is built up by directing the stream at a vertical base near the fire. This blanket forms a wedging effect and rolls on like an expanding lava, sealing out oxygen—fire's breath of life—while it seals in the gases to prevent their reignition.

Foam sprayed on a wall will insulate and keep fire from spreading. Used as a dike, it will stop running fires.



lets surrounded by air. Foam is a mass of air or gas bubbles, each one surrounded by a film of liquid. Six percent of that liquid is a "stabilizer," something to make the film tough enough to resist heat.

That is the second difference between fog and foam. Fog absorbs heat. Foam smothers whatever is burning.

Foam can be used alone on fires—especially petroleum-product fires—or it can be used with either fog or carbon dioxide, or both. Some bad shipboard fires have been put out by foam in heavy engagements in the Pacific. In one, a battleship's crew quenched a dozen bad fires in the course of an hour and saved the ship.

Foam can be made so tough that it will stand up under the heat of a blowtorch. Foam can be so constructed, in fact, that the heat from a fire will only tend to make its film tougher.

The related histories of fog and foam are associated intimately with the problem of wartime fire fighting in the armed services.

A study of wartime fire—especially that nightmare of the sailor, fire at sea—began

in the United States before we got into the war. Disturbing reports reached the Navy Department about the damage caused on combatant ships by fires touched off by bombs and torpedoes.

Then came Pearl Harbor. Jap bombs and torpedoes made a pyre of the Pacific Fleet's anchorage.

At that time a burly, 225-pound former battalion chief of the New York City Fire Department was in Navy uniform—commanding, of all things, a mine sweeper. Comdr. Harold J. Burke had entered the service the year before. He was an experimenter. And he believed in water fog and mechanical foam.

He knew that sheer human inertia had discouraged a wider adoption of water fog by municipal fire departments before the war. The Navy used neither fog nor mechanical foam. Fog was used sparingly everywhere, notwithstanding the fact that fire-insurance companies for years had rated fog's first cousin, the automatic sprinkler used in industrial plants, as 96 percent effective. *(Continued on page 107)*

FOG KILLS FIRE BY COOLING

Spurred by the wartime emergency, new discoveries in the war on fire have been made in the use of water fog—atomizing of water in recently improved nozzles. Fog is very effective on burning liquids. It robs the flames of heat, cools the liquid surface, retards the release of flammable vapors, and stops combustion.





CRASH FIRES at air bases are being whipped by carbon dioxide in mass application, supplemented by mechanical foam. This combination is effective where large amounts of gasoline have spilled from ruptured fuel tanks and cover much of the plane itself as well as a large ground area. The CO_2 , released at 0° F. , provides a slight cooling effect; the blanket of foam smothers the blaze, prevents reignition.

Speed is the key in attacking crash fires, so that attempts to rescue personnel can be started at once. Water spray is kept on fuselage to keep the interior cool, while path of foam enables rescue team to work.

Foam, fog, and spray are combined to extinguish the last of the fire. Fire fighters, knee-deep in foam, pierce the plane's fuselage with the javelin-type nozzle to flood interior with CO_2 .

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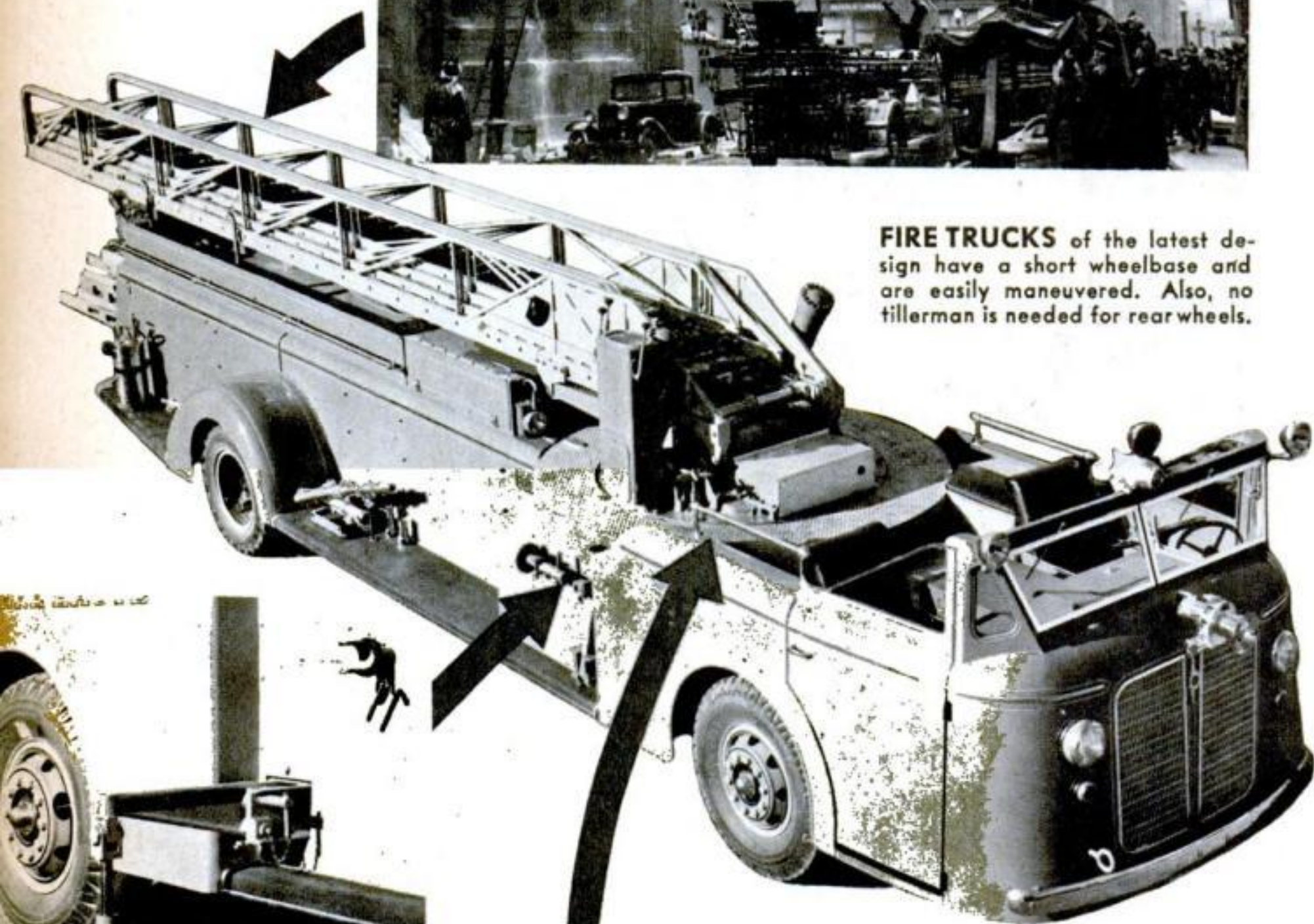
MODERN EQUIPMENT FIGHTS HOME-FRONT FIRES

AERIAL LADDERS

and a full complement of ground ladders feature the new fire-fighting trucks at home. Other modern equipment includes a ladder pipe for use at the end of an extended aerial ladder, an outrigger jack, and deluge guns to make large streams of water.

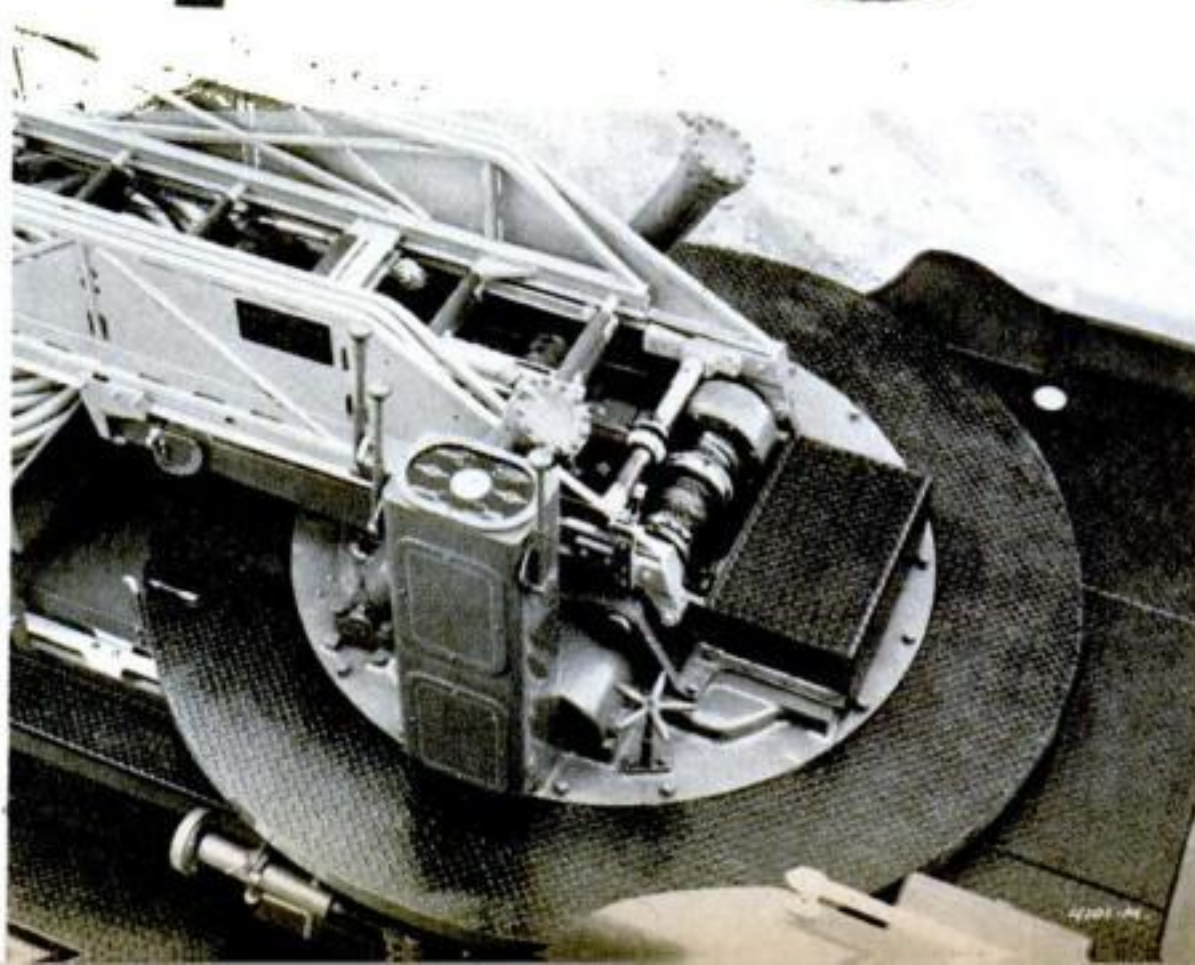


FIRE TRUCKS of the latest design have a short wheelbase and are easily maneuvered. Also, no tillerman is needed for rear wheels.



OUTRIGGER JACK swings out from side of truck to act as a stabilizer and to distribute the load when aerial ladder is used.

ALL-STEEL aerial ladder is raised, controlled, and lowered hydraulically from the main control platform.



"SMOKE SLEUTH" DETECTS SHIP FIRE, FIGHTS IT WITH CO



FIRE AT SEA is no longer the nightmare of the sailor if his vessel is protected by such a device as the Kidde Rich-Audio system. Formerly, a ship's officer sniffed at outlet pipes from each cargo hold for telltale smoke. Now, the slightest puff of smoke...

"Why aren't you fighting Navy fires?" Burke was asked by an officer who knew his background.

"I tried to get into that," replied Burke, pulling on his pipe. "No soap."

The other officer got busy on the typewriter. Burke was summoned to Washington by Admiral Chester W. Nimitz, then Chief of the Bureau of Naval Personnel. Some pictures of Pearl Harbor fires were tossed in front of him.

"Looks as though you've had a lot of fires," he commented dryly.

"Too many," was the answer. "What can you do? Write your own ticket."

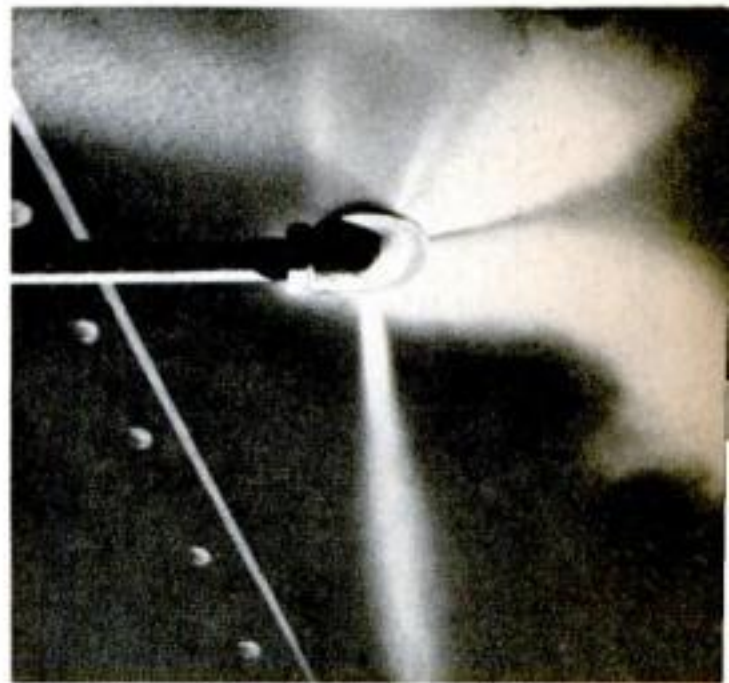
Burke started to work. Fire-fighting schools had been only in the talking stage before the Japanese attack. Now they began to get established—at Norfolk, Mare Island, Boston, Puget Sound, and Honolulu.

Burke "bulled through," in Navy parlance, the adoption of fog and mechanical foam. By the time we were ready for the invasion of Africa in the autumn of 1942, Navy ships were being equipped properly to fight fire.

The transplanted New York battalion chief discovered a little company in California, practically on



IS DETECTED electrically. The smoke is drawn into the detector cabinet where a foolproof system of lighting and mirrors and numbered flares indicates the source. A flip of a switch releases...



CO₂ TO THE RESCUE. The area is filled with carbon dioxide, and the fire dies. The only damage is the fire damage, for CO₂ is dry and noncorrosive.

MOBILE CARBON DIOXIDE. The Army's Cardox truck carries CO₂ in a refrigerated pressure vessel, at a temperature of 0° F., and a pressure of 300 pounds per square inch. When released, this liquid CO₂ expands several hundred times into a cloud of "snow" (dry-ice particles) and very cold CO₂ vapor. The truck's six nozzles, including the 15-foot-long boom nozzle, discharge its load at 6,000 pounds a minute.





FIGHTING FIRE UNDER DOCKS. The floating "Monitor" is the Coast Guard's latest device for extinguishing hard-to-get-at blazes under docks and among piles. A propulsion jet on the bottom of the float moves it in the water, and it is steered by two guide lines. With hose and guide lines, it weighs 116 pounds.

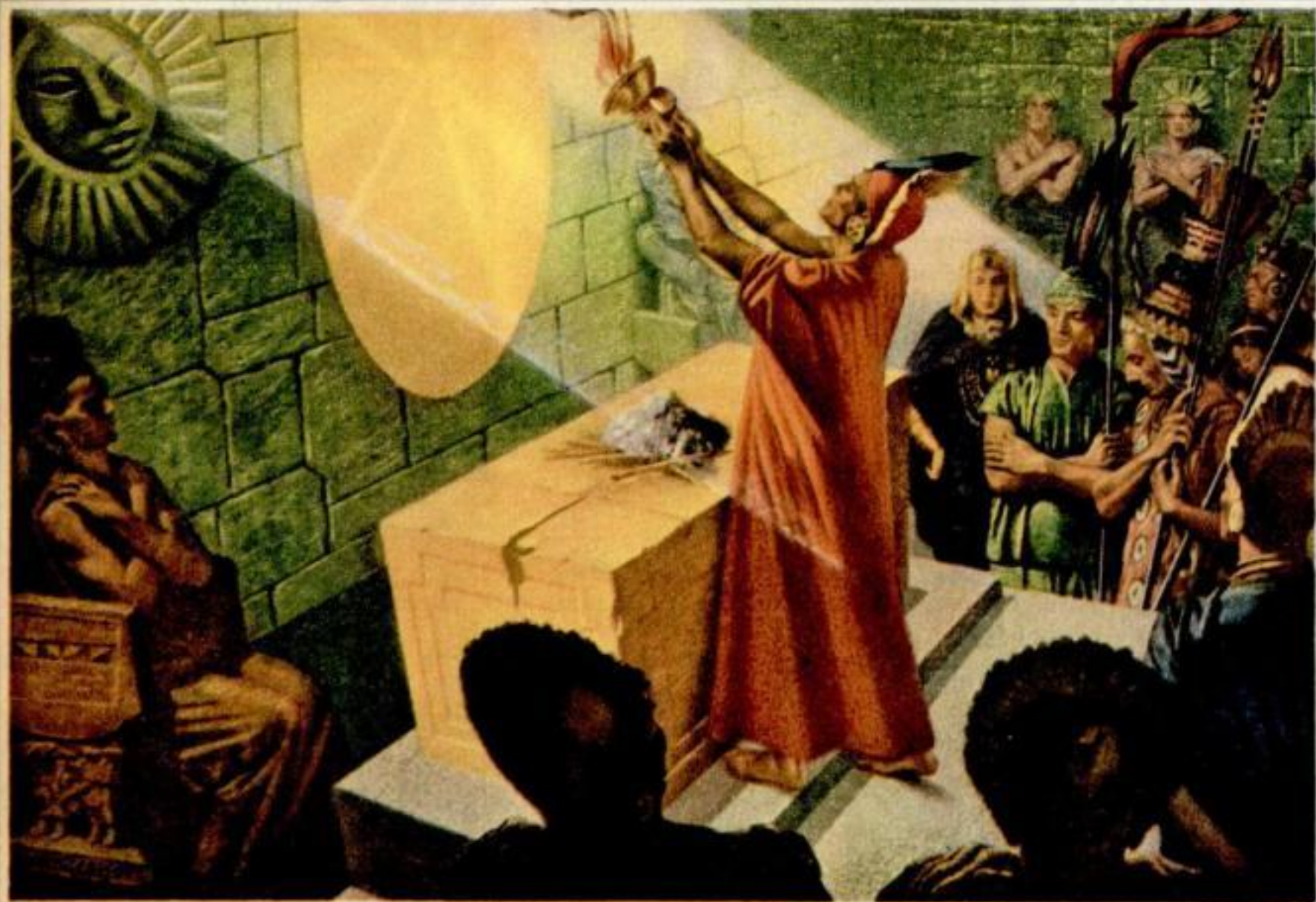
its uppers financially, that was turning out a superior fog nozzle. Today the Navy is buying all the nozzles that company can produce.

Burke knew that before the war foam had been used on some nonmilitary fires, but with indifferent results. There is a difference in foams. Some foam is chemical, produced by generating carbon dioxide gas. This gas fills the minute bubbles that make up the foam. An effervescent headache powder is an example.

Some foam is mechanical. The minute bubbles in the foam contain air. Soap bubbles are mechanical foam. So is the froth in the whitecap of a wave.

Soaps and other materials had been used as a stabilizing substance in the early mechanical foams, but it couldn't resist heat. Also, the Navy had used chemical

ANCIENTS WORSHIPPED FIRE AS POWERFUL GOD



In the magnificent golden Temple of the Sun at Cuzco, capital of ancient Peru, the High Priest raises the *chipana*, a highly polished golden cup, to the sun. In the center of this "fire bracelet" is a little cotton, which is set afire when the rays of the sun are concentrated within the cup. This interpretation by Francis Criss is one of a collection of original paintings portraying "The History of Fire." The collection decorates the offices of the Universal Match Corporation, of St. Louis, Missouri.

foam, but the equipment to produce it was cumbersome. Something highly portable was needed—and that's where the soybeans, fish scales, and iron salts come in.

With a protein extracted from the ubiquitous soybean—used for everything from food to automobile finishes—the National Foam System of Philadelphia produced what has come to be known as "Navy bean soup." It made possible highly portable mechanical-foam equipment.

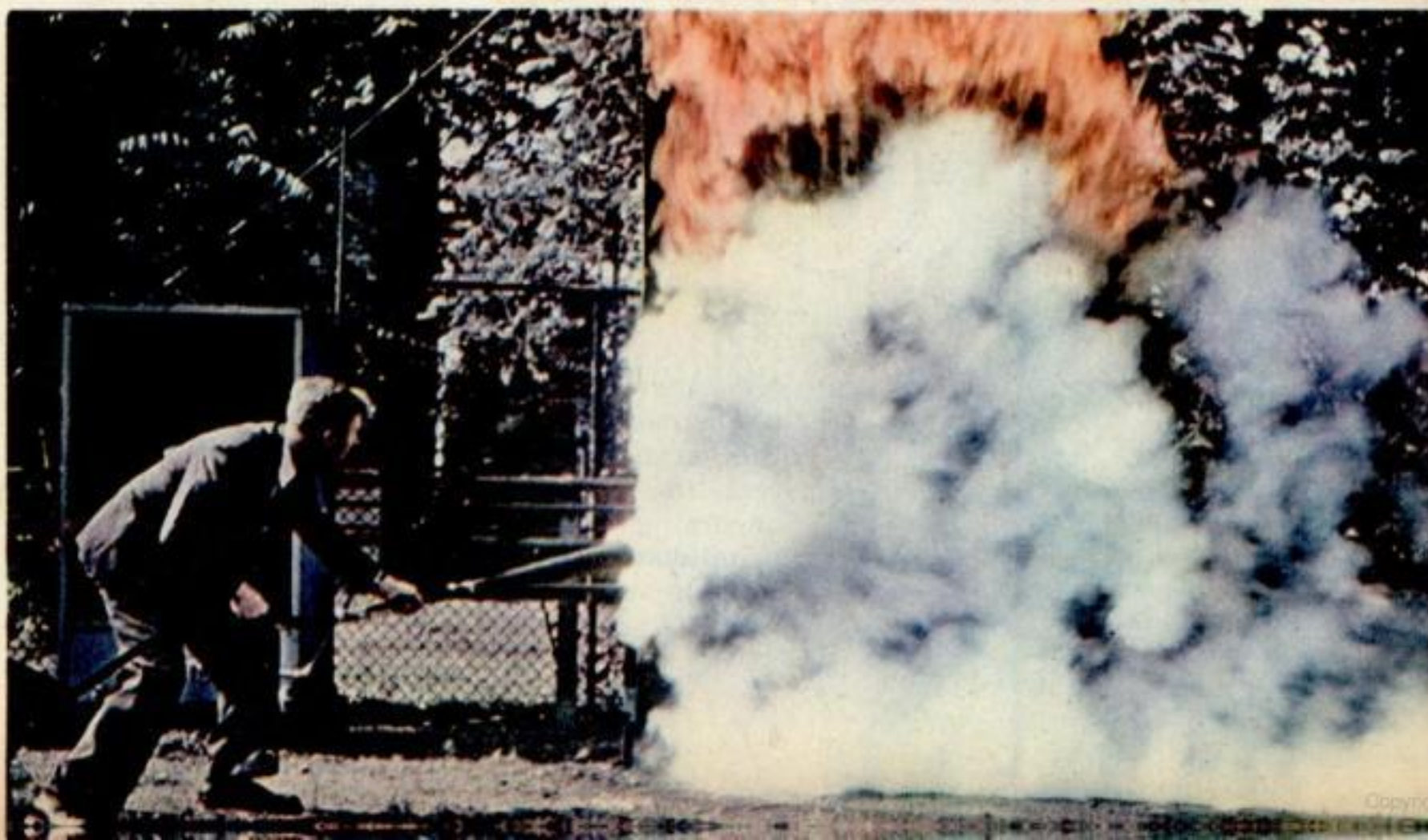
This foam resisted heat. It was stable, non-gaseous, and bland. A man could swallow it without injury. Best of all, it could be made with a hose, a special

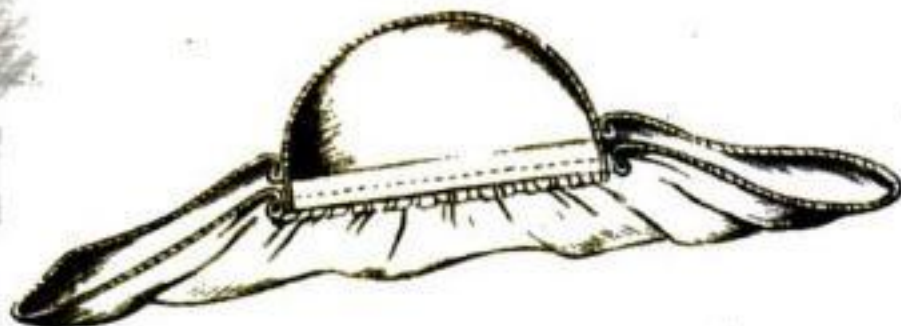
(Continued on page 207)

CARBON DIOXIDE KILLS FIRE BY REMOVING OXYGEN

The speed with which carbon dioxide quenches fire is demonstrated in these two pictures. A structure is completely enveloped in flames (right) as fire rages.

The fire-choking CO_2 is played on the blaze, and the area is instantly flooded with an inert gas that reduces the oxygen content of the air, stopping combustion.





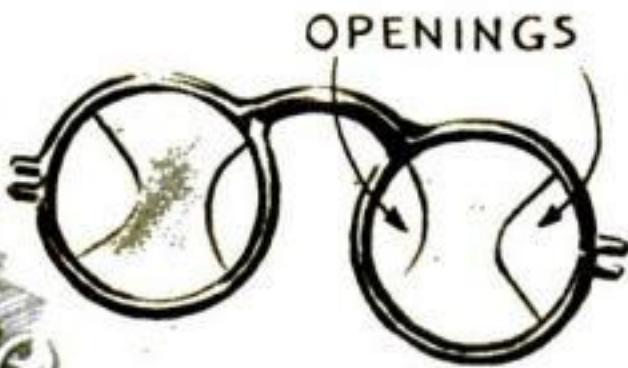
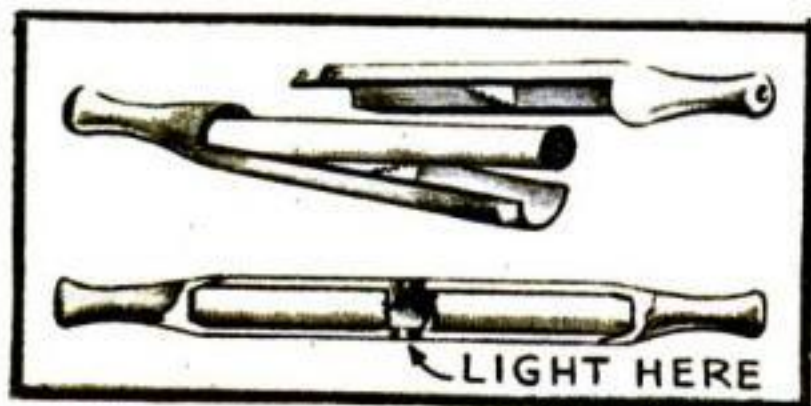
CONVERTIBLE HAT can be adjusted to the prevailing mode or to the style of hair-do. It is the invention of Klara Halmos, New York, N. Y. The crown remains the same, but the brim is twisted into a wide variety of shapes and secured in position by elastic.

ENJOYMENT OF SHAVING is a possibility for those who use the soapbox-top strop designed by Bernard F. Schulte, Highland Park, Ill. Flat, narrow strips of linoleum or leather are set into the cover of a wooden soap container, forming an even surface. On this buffer the blade is rubbed to reduce possible feather edge, eliminate rust particles, and restore its original smoothness. Results are similar to those obtained by the stropping of an old-fashioned razor, and the life of the blade is prolonged.

LEATHER OR
LINOLEUM
SET INTO
TOP



SMOKE THE WHOLE CIGARETTE with this holder originated by James Christensen, Englewood, Colo. Two identical parts, each with a mouthpiece, clamp together over a cigarette and cut it in half. The smoker lights up at a hole in the middle and smokes one half to the bitter end; then he turns the holder around and repeats the process.

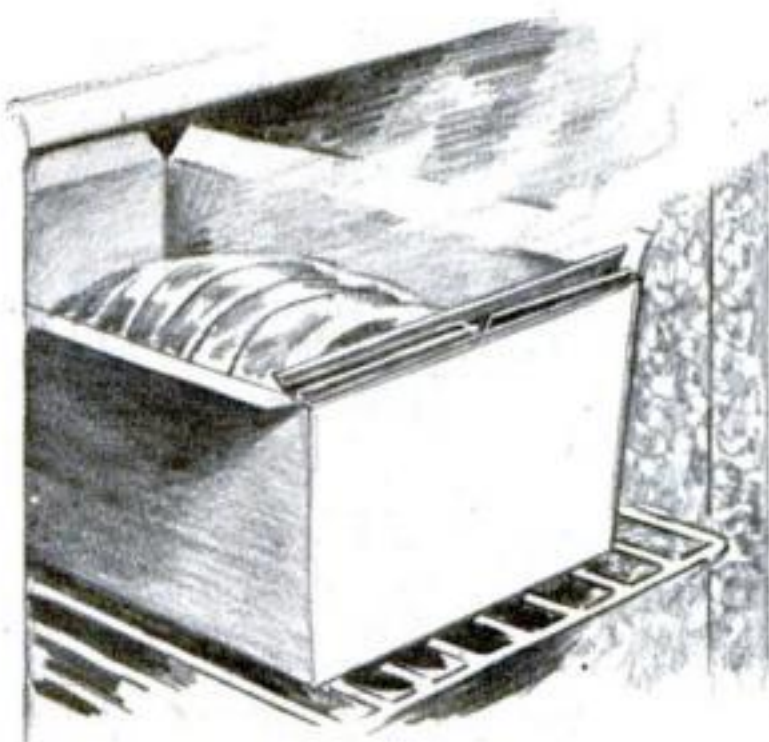
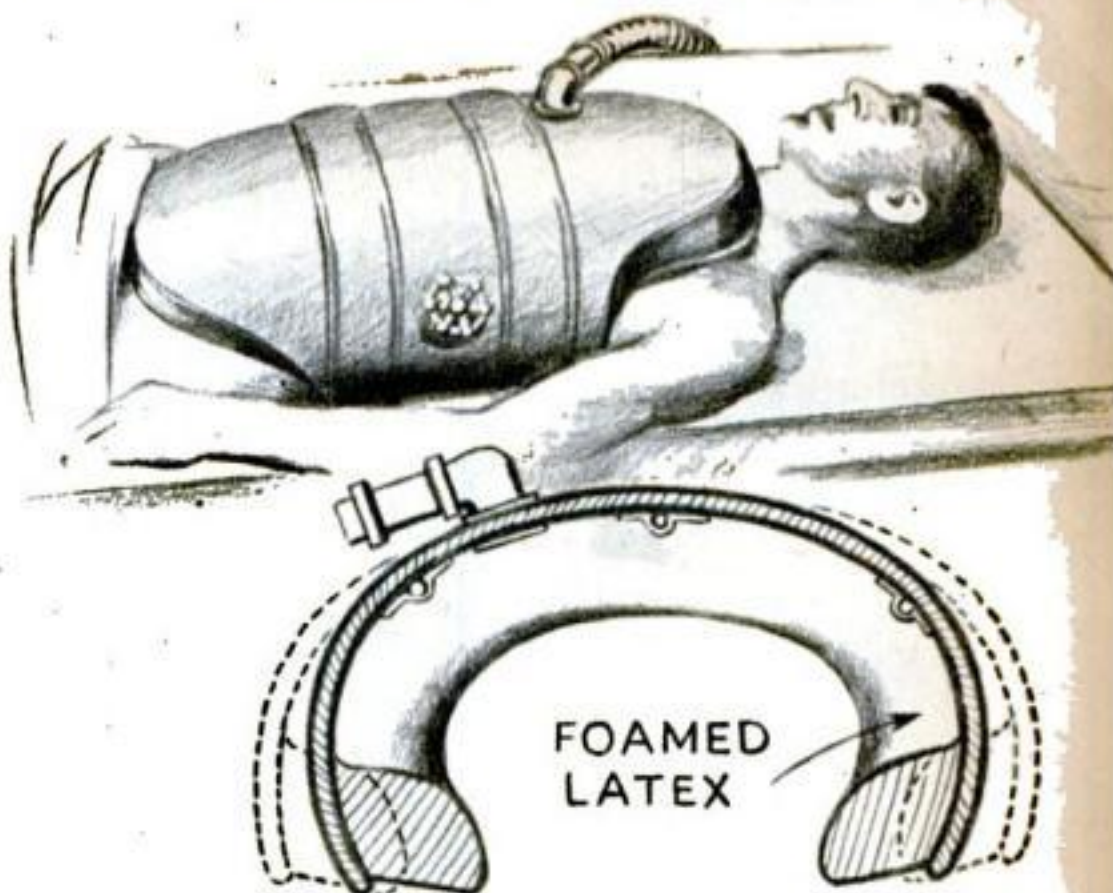


NONGLARE glasses specially designed for night driving and made either of glass or plastic, have been invented by Ruth B. Snyder, Bethlehem, Pa. The lenses, shaped somewhat like hourglasses, leave an open space for clear vision

on either side. Thus the wearer may have an unobstructed view of both sides of the road. Since the lenses are arranged so that they are in a direct line with the pupil of the eye, the glare of oncoming headlights may be met without the usual discomfort and danger. Open sides of lenses provide ventilation and prevent fogging.

the inventors

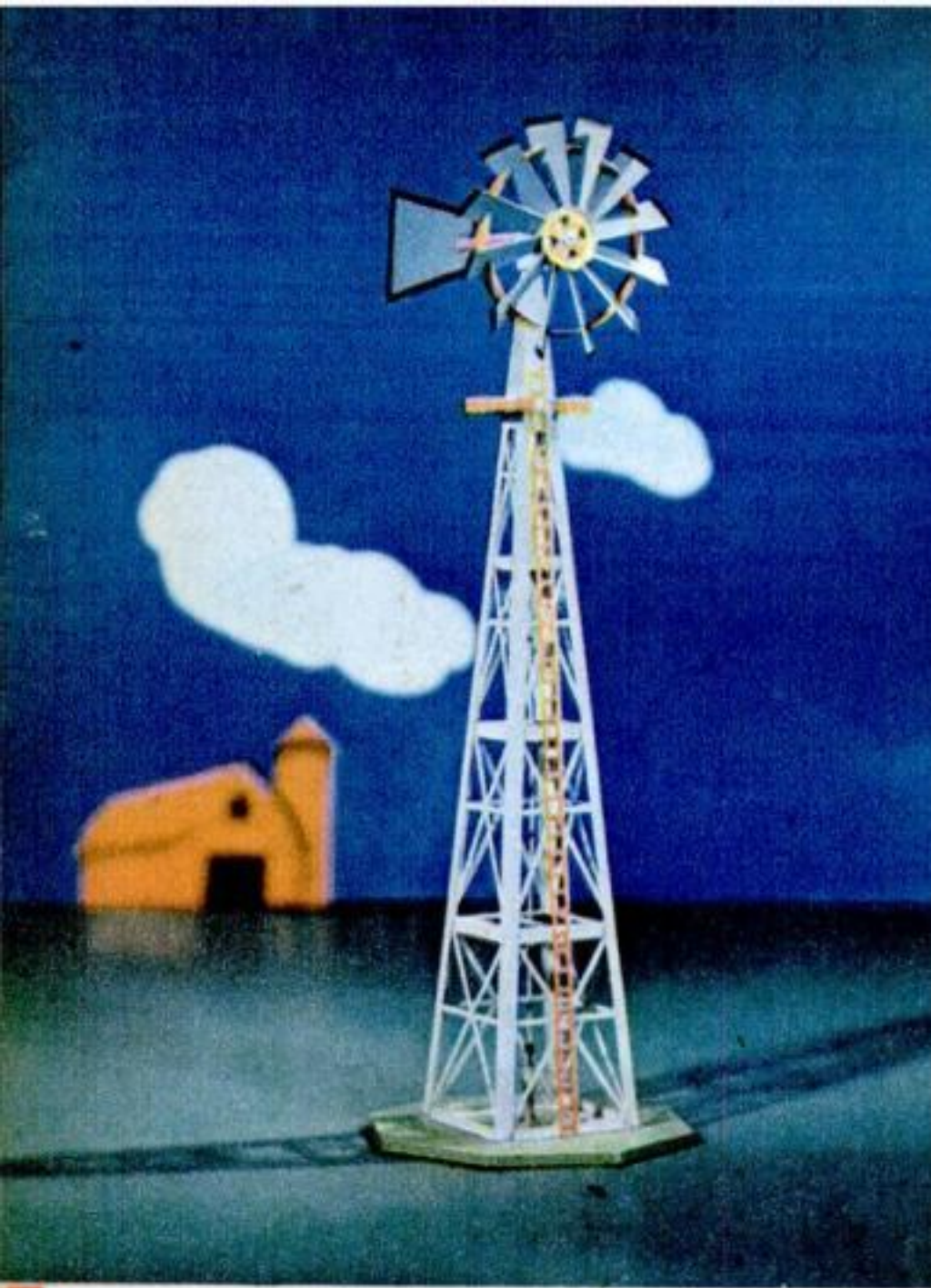
IMPROVED RESPIRATOR is made of lighter and less rigid materials than those in common use. A shield of rubberized fabric fits the body from the neck to the abdomen, and is spaced from the patient by an airtight wall of foamed latex rubber. Lengthwise rods give necessary rigidity while the respirator is in use, and crosspieces of spring steel hold it clamped against the body. A pipe outlet connects with a pump and control apparatus that cause the patient's lungs to contract and expand. The inventor is Franklin O. Church, Buffalo, N. Y.



COOKING MEAT IN A PAPER BOX is the purpose of the double carton designed by Christopher A. Pemberton, Toronto, Canada. It was made to supplant the metal pans commonly used for cooking meat loaves and delivering them to retail stores. Wholly constructed of a smooth-surfaced calendered cardboard, the inner section is creased into shape, while the outer box is similarly formed except for slits that permit the ends to be locked securely. The carton withstands cooking heat, and the seamless inside compartment does not readily absorb or release fats and juices from the meat. Outward-slanting sides make it easy to remove the loaf from the carton for the purpose of slicing.

HOW MANY MILES ON A CORD OF WOOD? A complete lightweight steam-power plant that can be attached to a bicycle has been designed by William H. Trippe, West Point Pleasant, N. J. Any solid fuel can be used, and the motorcyclist can rely on wood gathered along the highway if the need is pressing. Besides wood, the boiler is adapted for use with coal, coke, charcoal, briquettes, or similar fuels, a supply of which may be carried in a storage receptacle in the diamond-shaped opening just ahead of the rider's seat. A driving chain from a sprocket on the engine shaft connects with the usual sprocket on the rear wheel. The rider controls the engine by a throttle rod that extends to a lever on the handlebar, and there is a rim brake on the rear wheel that is operated by an easily reached foot button. The removable supporting framework of the mechanism may be built of lightweight rods or suitable tubular metal. Boxes for fuel, tools, and similar equipment can be made of either light metal or plastic.





Announcing the Winners of Our CARDBOARD CONTEST

FROM the many entries in P.S.M.'s cardboard contest, the judges picked the winning projects shown here. The working model of a farm windmill, which spins merrily at a breath, was awarded first prize. Second prize went to a picture frame for which cardboard was shaped into surprisingly strong and attractive molding. So evenly matched were the jeep and vase that the judges declared a tie and awarded duplicate third prizes. Here are the winners:

1st Prize: L. W. Brown, St. Peter, Minn.

2nd Prize: Alan Aston, Toronto.

3rd Prize (Tie): A. A. Avritt, Owensboro, Ky., and Mrs. Roy Clark, Wichita, Kan.

4th to 10th Prize: Albert Schulz, Teaneck, N. J.; Paul Krizsan, Davenport, Iowa; William H. Scheiman, Fort Wayne, Ind.; Mariellen Whelan, Ridgewood, N. J.; Mrs. Eva C. Couch, Lynn, Mass.; B. Broth, Brooklyn, N. Y.; and Robert Weinstein, Los Angeles, Calif.

1st PRIZE

This windmill, built entirely of cardboard by Lawrence W. Brown, will really work. It is extremely sturdy in spite of its cardboard construction and is a fine working model, worthy of the \$25 first prize.

2nd PRIZE

Combined projects are shown at right. The picture frame captured second place, while a special prize went to the bas-relief flowers, cut from corrugated cardboard. Alan Aston made the frame, Mrs. Eva Couch the flowers.



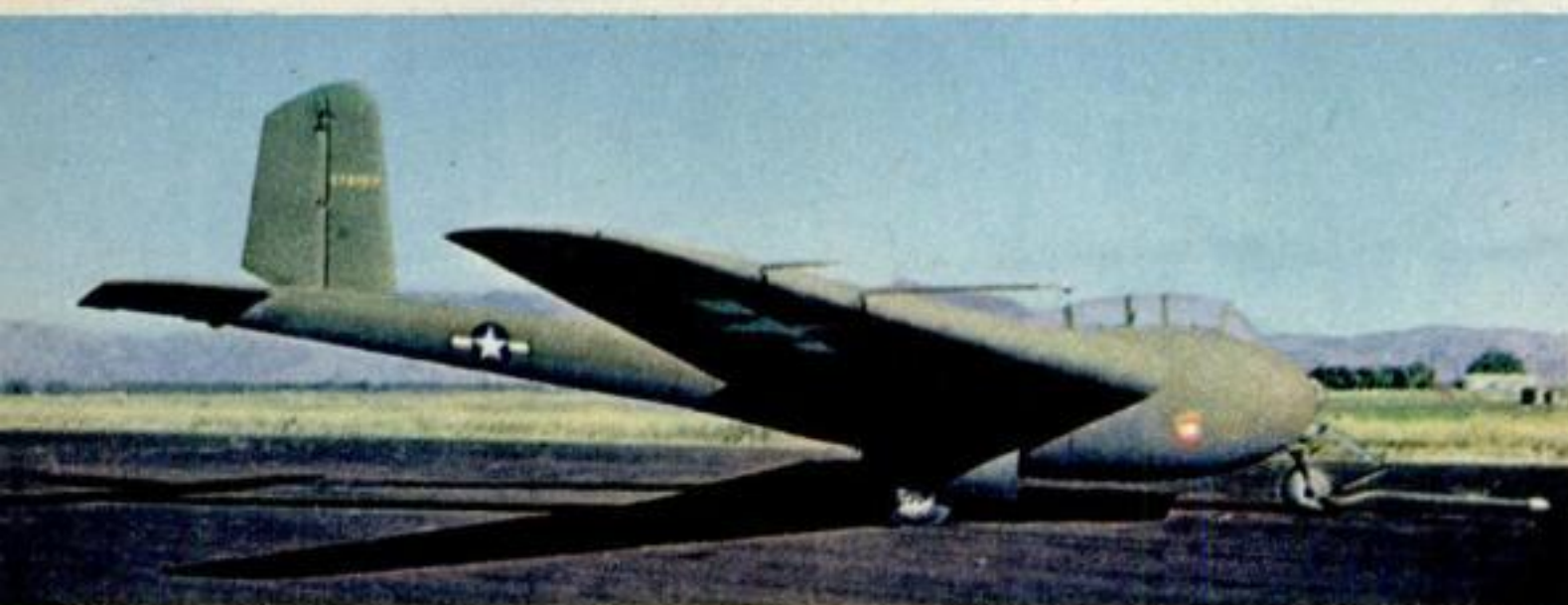
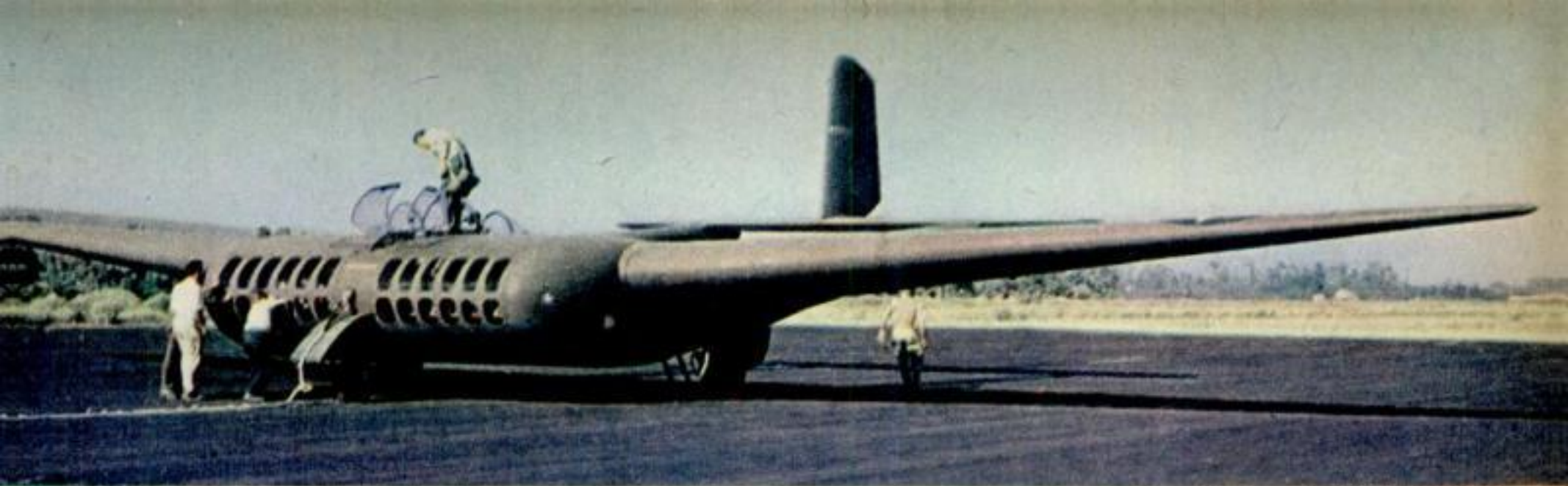
3rd PRIZE

Embossed handwork on this vase is papier-mâché from cardboard pulp. The piece, submitted by Mrs. Roy Clark, was painted after modeling and, though light, is quite sturdy.



3rd PRIZE

Tied for third place, this cardboard jeep shows remarkable detail. The wheels were made by A. A. Avritt by gluing up several layers of cardboard, then turning them to shape on a lathe.



Photographs by Dr. L. P. Clarke

This two-room flying-wing glider can be towed at 200 m.p.h. carrying 42 men or a pay load of 10,080 pounds. The twin noses are shut before take-off.

Cable becomes taut as the big XCG-16 begins to roll. A speed of 70 m.p.h. lifts it. On landing, its hydraulic brakes stop it within 400 feet.

42-Place "Wing" Glides at 200 M.P.H.

PLYWOOD SHIP CARRIES FIVE TONS OF TROOPS, GUNS, OR SUPPLIES

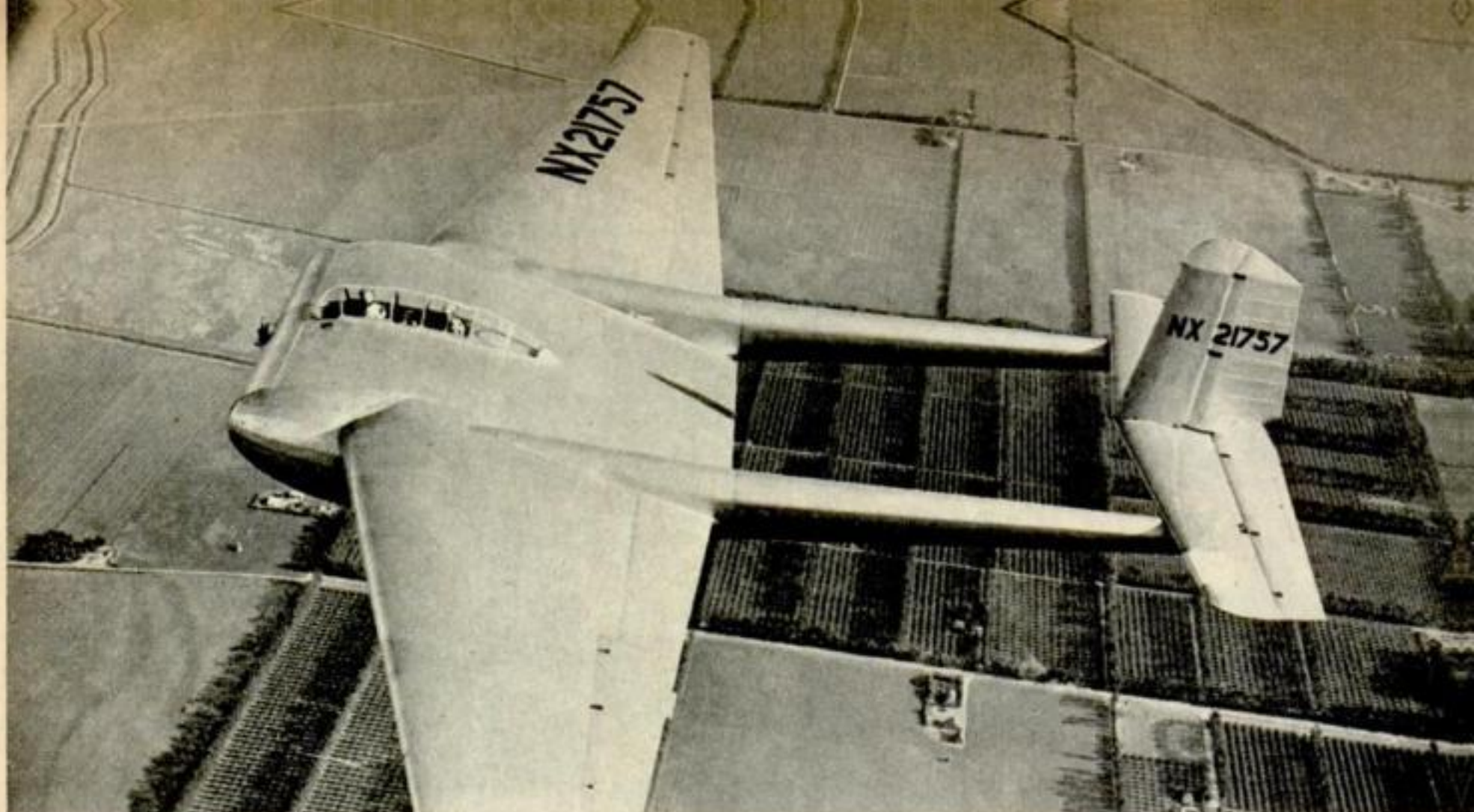
A TWO-ROOM wing now carries more soldiers than one of the French 40-and-eight boxcars used in World War I. Twenty men ride in each room, and two pilots occupy a transparent compartment on top of this 200-mile-an-hour glider.

Instead of one nose and cargo chamber, the XCG-16 has two, side by side. Many

combinations of heavy materiel and men can be stowed inside this aerial invasion craft in a few minutes, and unloaded five times as fast at an airhead. Fully loaded, the glider weighs nearly 10 tons. It is a twin-boom, high-wing, land monoplane, with retractable landing gear. The two-spar wing, built of wood and plywood, is

The "wing" glider was not built for men only. Here, a 105-mm. howitzer (4,300 pounds), ammunition, gun crew, and airborne troops pose in front of an XCG-16. Glider may be loaded in 10 minutes, unloaded in two.

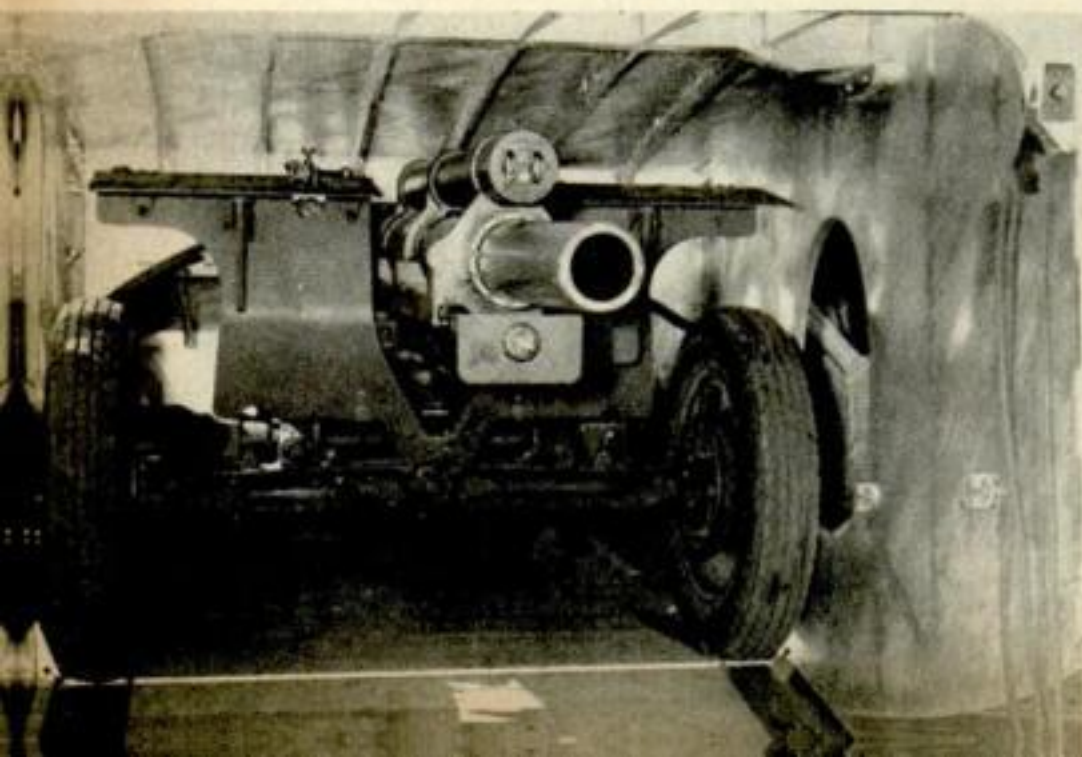




Designers envision the wide use of gliders for long-distance hauling of cargo after the war. The twin-boom, plywood-covered XCG-16 needs only 520 horsepower in the tow plane to pull it forward at 140 m.p.h.



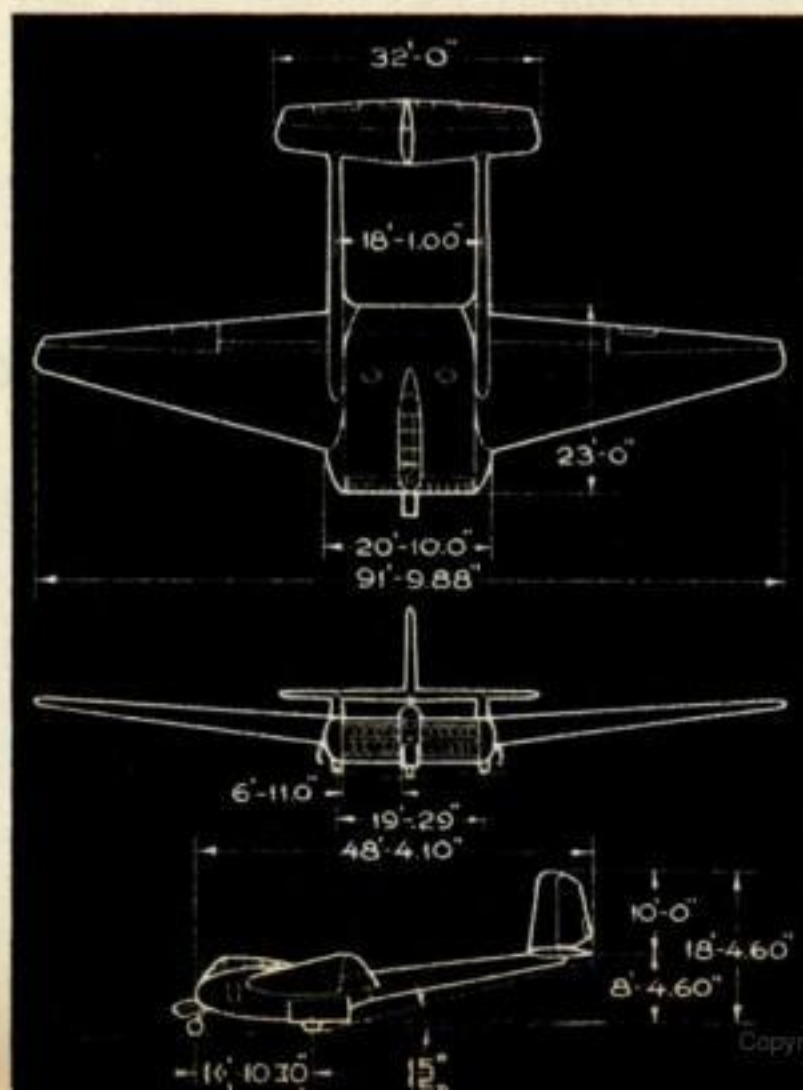
Each compartment of the glider holds 20 men equipped for battle. Cased ammunition is stacked in the aisle. When a 105-mm. howitzer is secured in one compartment (below) its crew and a supply of shells may be carried in the other one.



longer than the sides of a baseball diamond. An electrical generator, driven by the wind, charges a battery which provides power for six motors that are used to operate the flaps and landing gear.

Designed by glider veteran Hawley Bowlus, the XCG-16 was built by General Airborne Transport Co., and test-towed behind a four-engine plane from California to Dayton. Bowlus foresees extensive use of such Siamese-twin gliders as fast, flying freight cars.

This three-view drawing of the XCG-16 reveals its hugeness. The tricycle landing gear is fully retractable, electrically and manually.

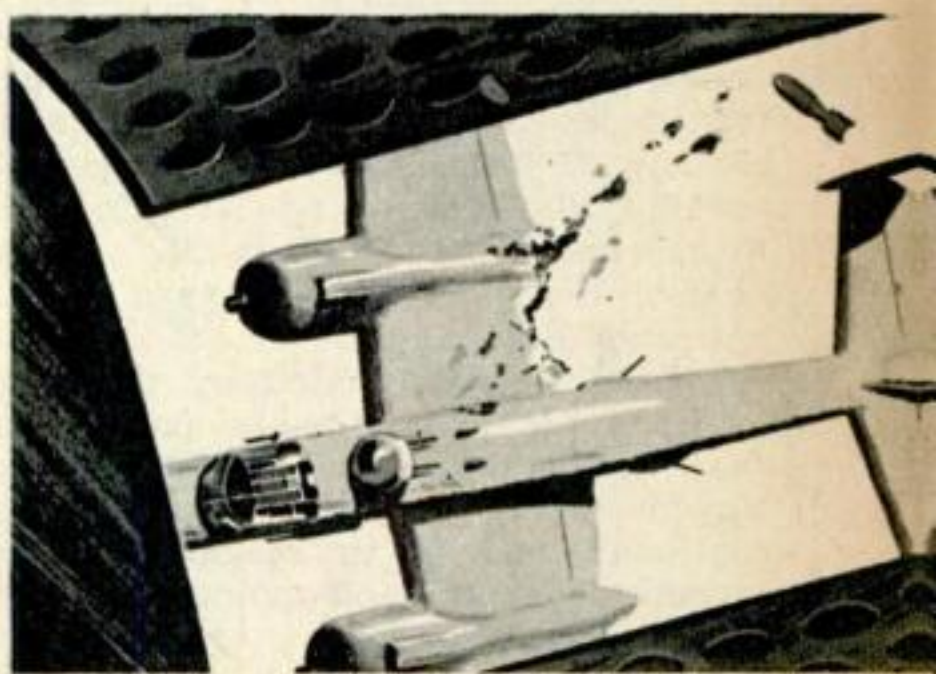




DISASTER TAKES A HOLIDAY

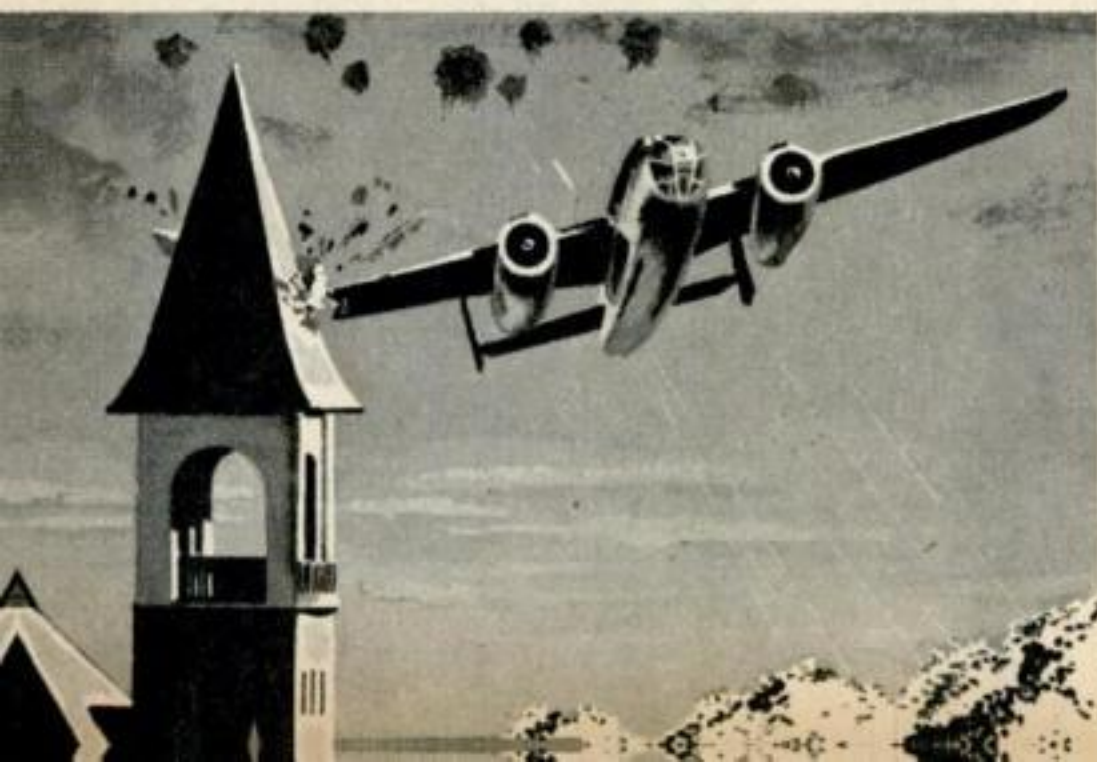
Here's how some B-25's
squeaked through.

DIRECT HIT. While this B-25 Mitchell medium bomber was on a mission in Tunisia, an 88-mm. shell struck it near the nose-wheel well. The pilot was fatally wounded, instruments and gear shattered. Under intense ack-ack, copilot brought ship back.



BOMBED by a sister plane. This Mitchell broke formation and flew beneath a just-launched bomb. Bouncing off the fuselage, the missile bit a sizable mouthful out of the wing and the right nacelle.

BOMBER WENT TO CHURCH. Another of these mediums was running from enemy fire. The bomber had flown almost out of danger when a church spire got in the way and sheared off four feet of the right wing. With the home base several hundred miles away, the skilled pilot carried on and succeeded in reaching home "on a wing and a prayer."





VENTURA IN FLIGHT. This Vega patrol bomber, designated by the Navy as PV-1, was used on bombing missions to Japan's Paramushiru from the Navy Air Base in the Aleutian Islands. The ship carries a crew of four and can carry either bombs or depth charges. Its speed is over 300 m.p.h.

The Versatile Ventura

THIS NAVY PATROL SHIP, THE PV-1, RAINS RUIN ON JAPANESE LAND AND SEA FORCES WITH BOMBS, DEPTH CHARGES, TORPEDOES

YOU can't be absolutely sure of seeing a Ventura. It is painted blue on top and white underneath, so it's hard to spot from either above or below it. From above, seen against the water, the blue top fades into an almost invisible shadow. If it is hard to find, once discovered, it's harder yet to keep in sight. From underneath, the white bottom against the average sky has a similar optical effect.

This plane, designated by the Navy as PV-1, is a land-based patrol ship that carries bombs, depth charges, or torpedoes. The Ventura has proved exceptionally useful in reaching distant targets from take-off points on small land bases. It carries a crew of four. With its two engines—2,000-hp. Pratt & Whitney Wasps—the speed is somewhat more than 300 m.p.h. and the service ceiling above 25,000 feet.

Wing span of the Ventura is 65½ feet, while the length is 51 ft. 5 in. and the height 11 ft. 10 in. It has a Hamilton Standard three-bladed hydromatic propeller. A chin turret enables her to strafe as she goes after an enemy ship loaded for the knockout blow with a 2,000-pound torpedo.

ENGINES are 2,000-hp. Pratt & Whitneys driving three-bladed full-feathering props. The mechanic working on top of the nacelle is installing a screen on the air intake over the right-hand engine.





WHITE BELLY makes PV-1 hard to see in the air. Blue top makes it practically invisible from planes above.

TORPEDO GOES ABOARD. It's 13 ft. long and 18 in. thick, weighs a ton, and has a speed of 30 knots. Note the plane's .50-caliber "package" guns carried in the chin to make it extra hot for the enemy.



2,000-LB. BOMB is an alternative load. Here one of them is shown being wheeled on a dolly between the open doors of the bomb bay. It will then be slung on the rack to wait delivery to the enemy target.

FOUR TIMES 500. Destruction in quarter-sized packages is carried in these four 500-lb. bombs being put aboard the Ventura. This plane also totes depth charges. The total bomb load is about a ton.



NEW PLASTIC VARNISH

ORIGINATED FOR COVERING LABELS, IT HAS MANY USES

By KENNETH M. SWEZEY

SMUDGED, stained, or otherwise illegible labels may be dangerous. At best, they are time-wasting. You don't want to stop to figure out whether a bottle contains sal soda or sal ammoniac. Harold Frediani, young chief chemist of Eimer & Amend, New York City, wanted something that would protect the labels on laboratory bottles from chemical action. So he originated a new water-white and waterproof varnish made from a solution of polystyrene plastic. It did the trick.

Spread it on the surface, and in about five minutes there is a dry, transparent film. It is tough, flexible, waterproof. In addition to those qualities, this glaze is highly resistant to acids and most other strong chemicals. Polystyrene thus chalks up one more achievement on the long list to its credit.

Such an efficient coating, so easily applied, will probably have a great variety of uses in homes and offices as well as in labora-

tories. A thin layer of it smeared on any kind of label or card—written, printed, or typewritten—will protect it against wear, dirt, moisture, or carelessness. If the surface gets soiled, you simply wash it.

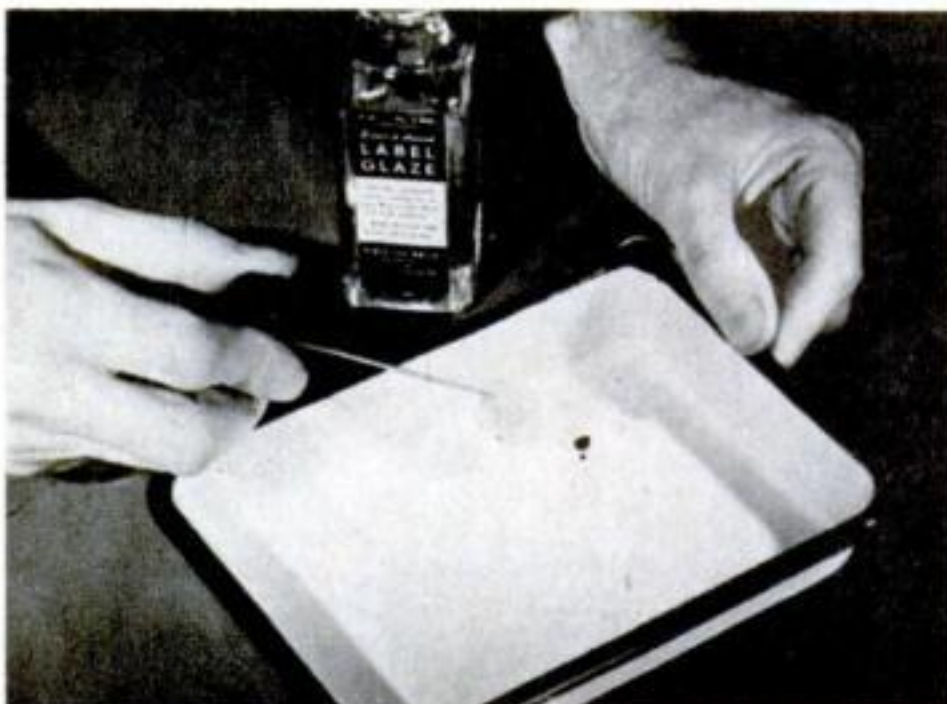
Office use includes the coating of the labels on filing cabinets, storage drawers, and pigeon holes. On file cards that are being handled constantly, the glaze protects the lettering against perspiration and smudging. It also makes a durable covering for papers and cards that must be carried in the pocket, such as draft, identification, and social-security cards, passes, and similar articles.

In the home, this polystyrene solution may be used on bottles in the bathroom or kitchen, where steam is likely to cause labels to drop off, and on fruit jars stored in a damp cellar. Coasters and place mats coated with label glaze will last longer and be easier to clean.

Many other uses will doubtless suggest themselves, but one of especial interest at this time is the treatment of photographs of men and women in the service. Coated on both sides, such pictures will resist moisture and may be washed when they become soiled. Also, a coating over the address on a package going overseas lends added insurance against damage by water.

A snapshot can be dipped in water or washed without harm if it is first coated on both sides with the new polystyrene plastic solution that was developed for labels.

Most chemicals do not affect this novel glaze, so it can be used to cover up chipped spots on photographic trays.





Both the labels in the picture above have been dipped in the beakers of sulphuric acid. The plain, untreated label at the left disintegrated as far as the acid touched it. Label at right, previously covered on both sides with the chemical-resistant solution, showed no effect from immersion in the strong acid.

Polished metals also can be coated with this new polystyrene solution with the same effect. Chipped trays used in photographic work, or other enameled ware not subjected to heat, are kept from rusting by an application.

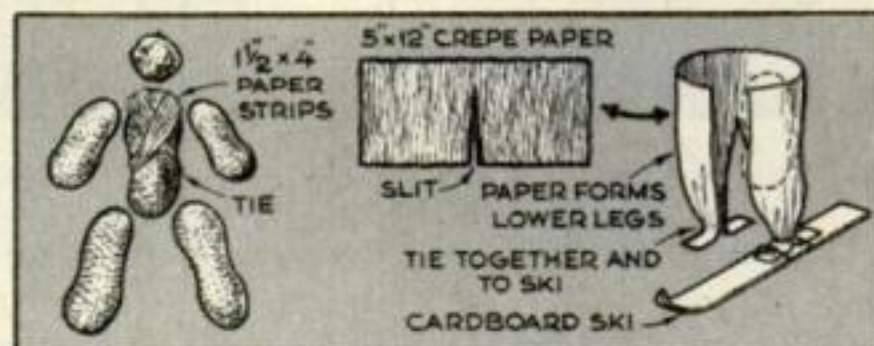
The best solvent for polystyrene is carbon tetrachloride. The label glaze stands up under strong acids such as nitric, sulphuric, and even hydrofluoric, the glass-eating acid—an important consideration when it is used in the chemical laboratory.

Many household uses include the coating of labels on fruit and vegetable jars that may have to withstand storage-cellar dampness; also the protection of table place mats and coasters against moisture.





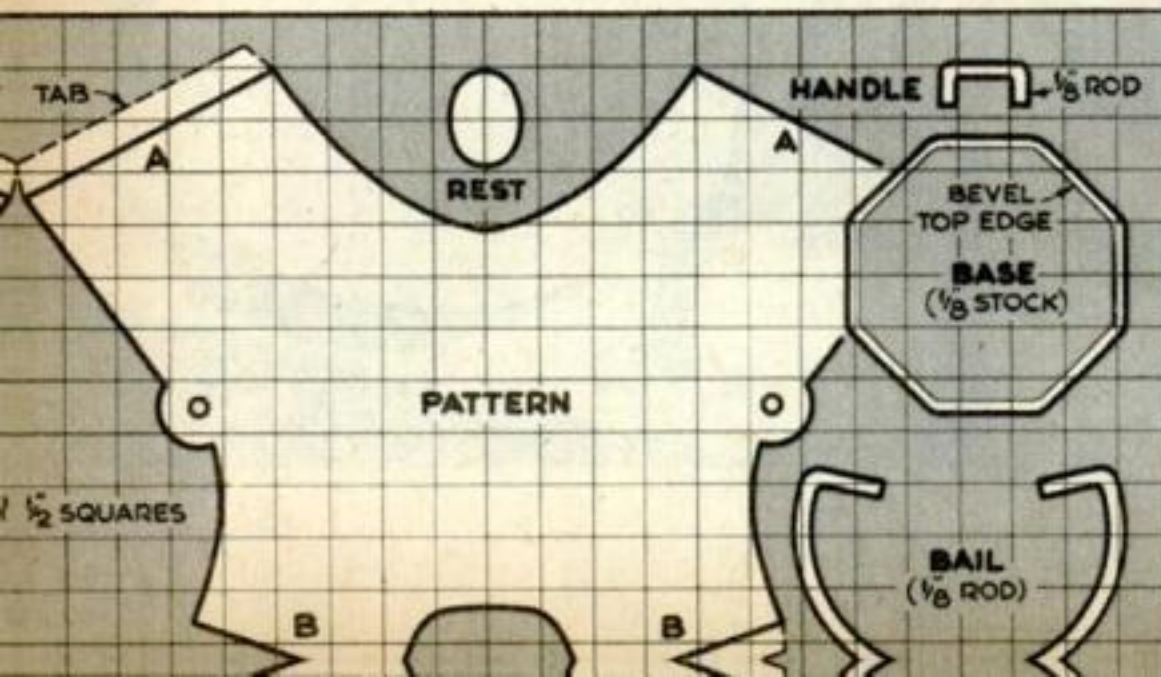
TABLE-TOP SKIERS lend a fillip to the festive board as place marks or party favors. Each head is a single-peanut shell; each body, a double or triple shell; and each arm, a double shell. Make the clothes from crepe paper, the hair and belts from yarn; and the skis from blotters.



SCUTTLE THOSE BUTTS in this coal-scuttle ash tray. Made of brazed sheet brass, welded black iron, or soldered tin-can stock, it has a large capacity and two convenient cigarette rests. For soldered construction, include the tabs that are dotted on the pattern and fit the handle by punching two holes in the scuttle, inserting the legs about $1/16$ " and soldering from the inside. For brazed or welded construction, butt all joints. Secure the rests to the bail after fitting it in place. Fasten the body to the

heavy base from the inside. Brass can be buffed to a high luster or wire-brushed for a dull finish. Humbler material may be painted flat black inside and any desired color outside.—JOHN DAUGHERTY.

120



Eine Bombensache!

日本文揮ヲ九三示ス
聯合軍兵士ニ對スル命令書

Treat him courteously and conduct him to headquarters.

คำเตือน! คำเตือน!



เทศบาลตำบลตาบ จ.ธรา
 ชาญได้รับ ในการร่วทางลั

ພ່າງ ແລະ ອື່ນໂຈ້ນຢັ້ງເກດ:-

WARNING! WARNING!

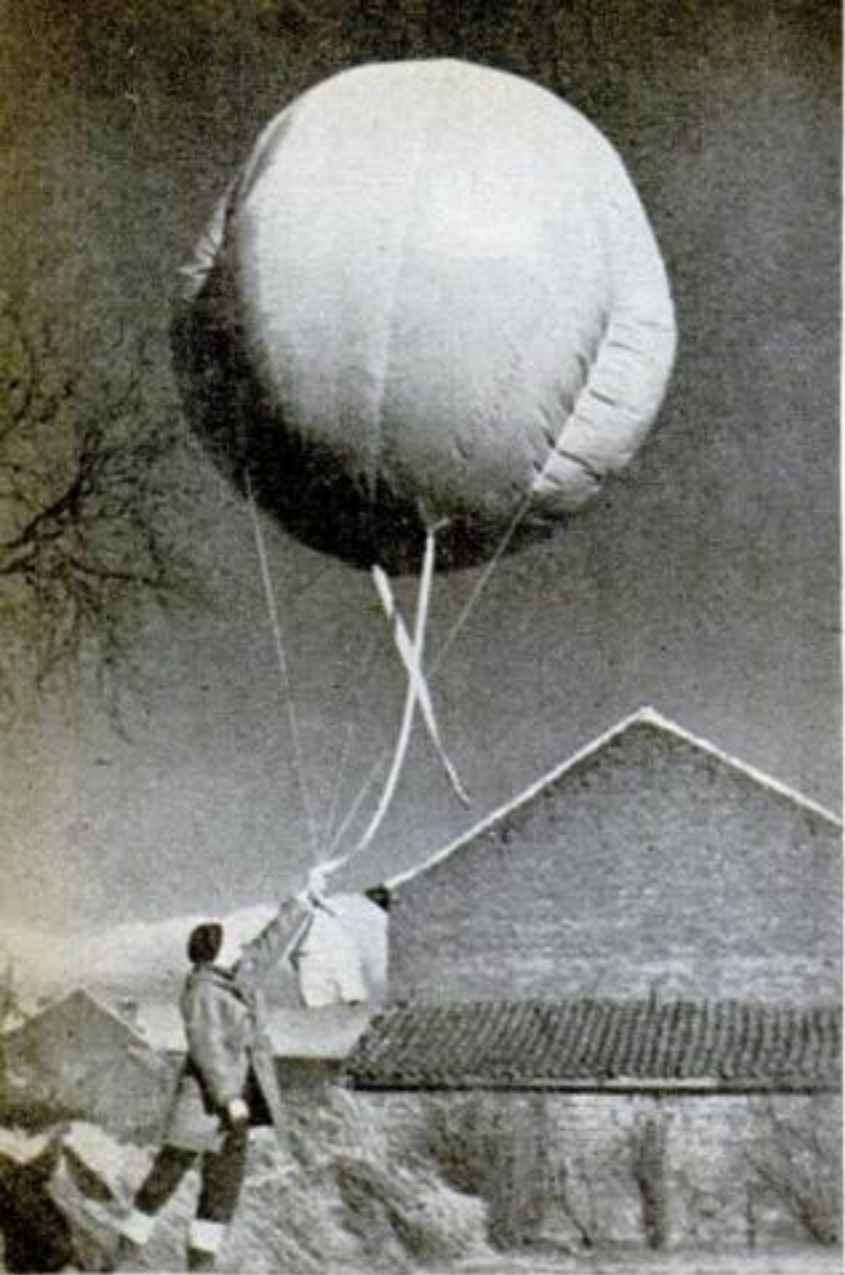


Again we warn the people of Siam—as we are warning the people of

Leave before it is too late

By TOM MAHONEY

While much more fanatical than the Germans and Italians encoun-



BALLOONS DROP "PERSUADERS." At the left, a 10-foot gas bag takes off to drift over Germany with a load of propaganda leaflets and surrender passes. A time fuse (right) burns through strings to release ballast and drop papers on the designated areas. Finally, the balloon blows itself up.



SHELLS scatter leaflets addressed to specific enemy units, describing the hopelessness of their situation and urging them to give up. These are 25-pound projectiles.

BOMBERS shatter the foe's morale with literature packed in the fiber cases in which bombs are delivered to fields.

tered earlier, even the Japanese are not immune to propaganda—especially when it is accompanied by visible force. Radio Tokyo has been hysterical in warning the Emperor's subjects against listening to American broadcasts and reading the leaflets dropped by the raiding B-29's along with their bombs. There is reason for this.

On Noomfoor Island, for example, 65 out of 210 Japanese and 200 of 576 Formosans who surrendered asserted that they had been influenced to do so by leaflets. In many phases of the Burma fighting, Japanese came into the Allied lines waving surrender leaflets that had been dropped over their positions by American planes. A combination of public-address and leaflet propaganda induced 250 natives to desert the Japanese at Myitkyina and bring with them information that contributed to its capture. In Europe, Germans and Italians were in-





TACTICAL USE OF PSYCHOLOGY was illustrated when General Eisenhower radioed a warning for civilians to leave the Ruhr. German reserves moving in to meet the threatened attack found the roads clogged with refugees. Carts and barrows piled with household goods blocked trucks and armor.

duced to surrender in groups of as large as 3,000.

Most leaflets have been tossed from airplanes, as a matter of convenience. It was discovered that the fiber cases in which medium-size bombs are shipped make an ideal container for dropping leaflets clear of the airplane carrying them. The cases have been used frequently for this purpose.

Some of the most effective leaflets are for use against a definite unit in a particular locality. Fluttering pieces of paper, correctly identifying his unit, listing his officers by name, mentioning the kind of food issued the day before, and informing him that he is surrounded, go far toward depressing even the toughest enemy. Information for messages of this type is obtained from newly captured prisoners and is printed by Psychological Warfare teams on semiportable Davidson presses close to the firing line.

"HOG CALLERS"—loudspeakers mounted on trucks—roll through captured towns, booming warnings for snipers to give up. It's a dangerous form of psychological warfare.

To insure accurate delivery of special leaflets, the British developed in North Africa a new type of shell that can be loaded with leaflets and fired by artillery so as to explode exactly over the enemy unit. The leaflets then fall in a small area. Leaflets have also been strewn behind enemy lines by patrols and underground agents. Special leaflets have been directed, of course, to residents of occupied countries and enemy civilians as well as enemy soldiers.

A typical "surrender pass" folder directed to Japanese units ([Continued on page 206](#))



Secrets of the German Jet Planes

Popular Science brings you the inside story of the Luftwaffe's last desperate gamble to wrest air supremacy from the Allies.

By **MATTHEW HUTTNER**

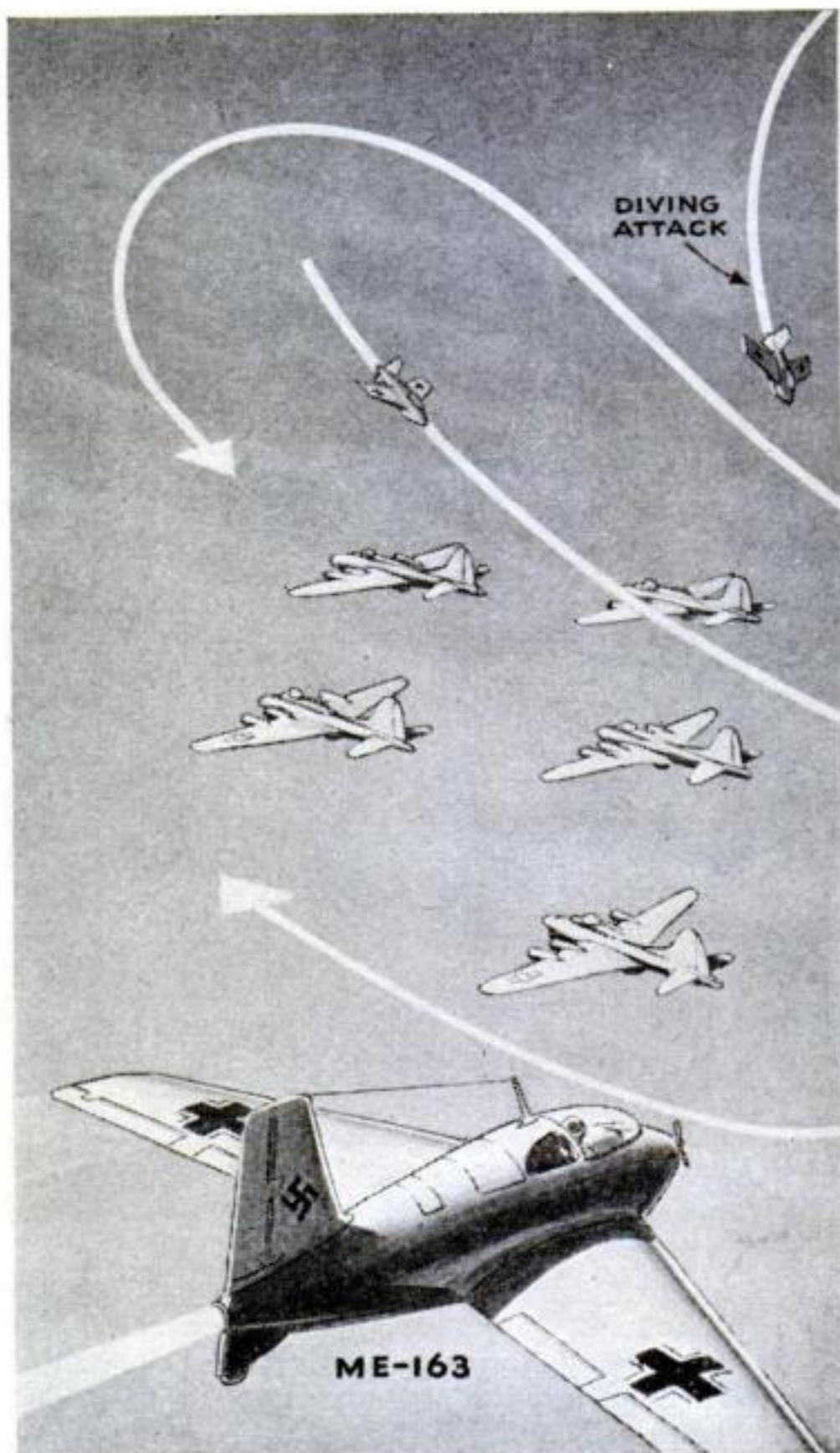
Captain, USAAF

Drawings by B. G. SEIELSTAD

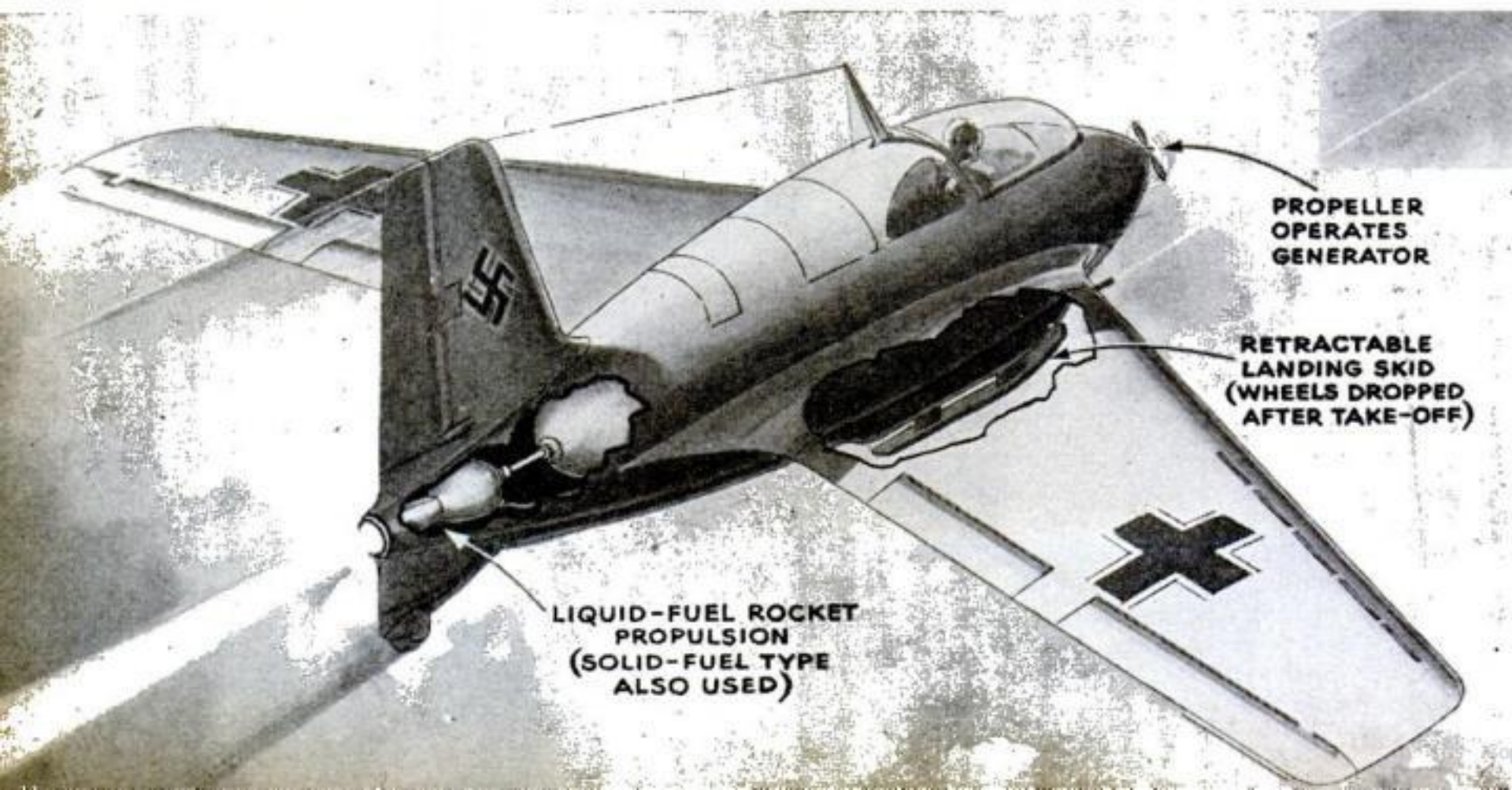
TWO Eighth Air Force Mustang pilots cruising over Germany on July 28, 1944, must have thought they were nearing Mars. What appeared to be a Buck Rogers version of the flying wing zipped past them like an express train through a whistle stop. It was a rocket-propelled ME-163, pioneer of the German jet threat.

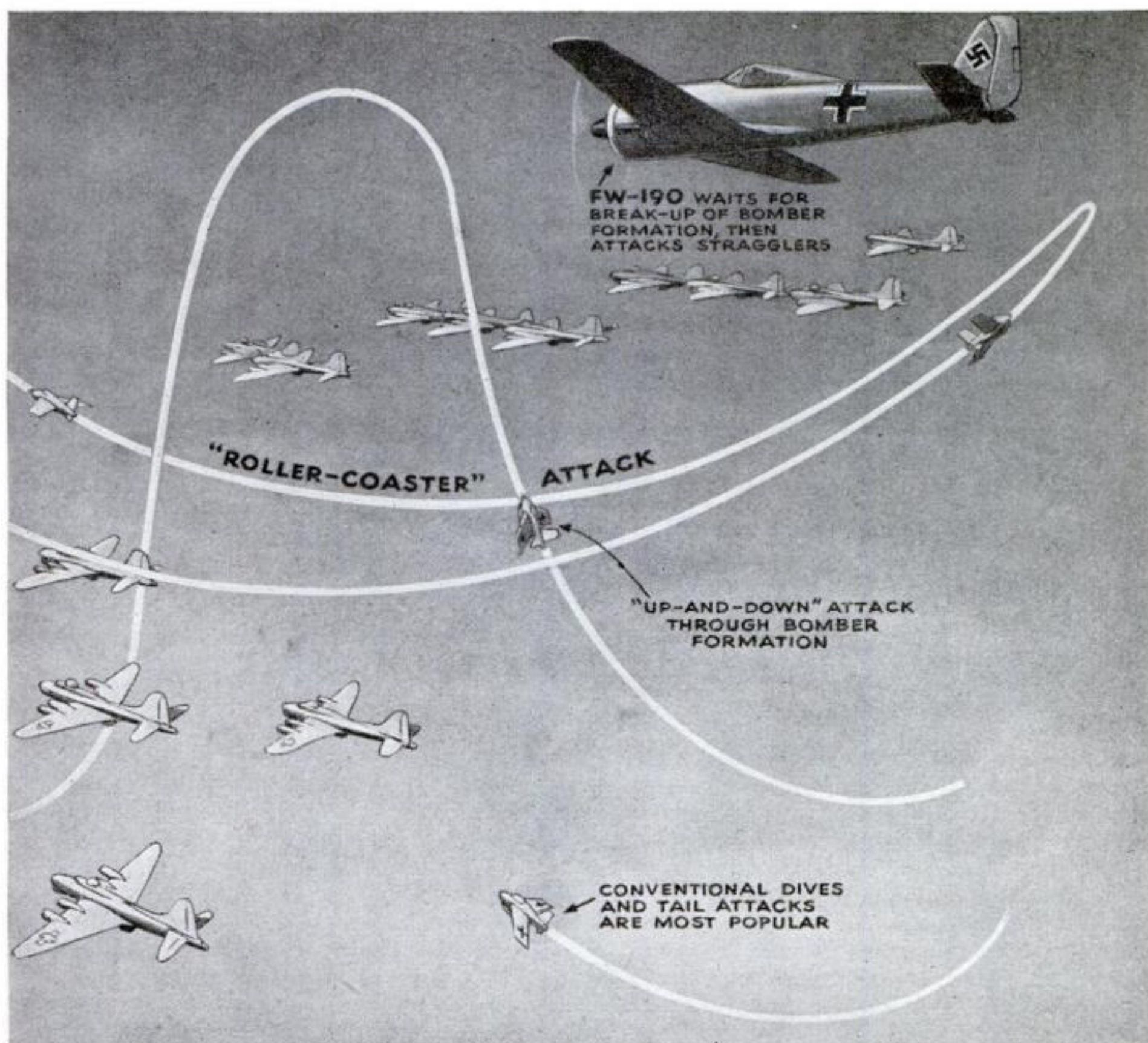
For three years Allied air experts had been expecting that day. They had reports of jet designs under consideration by Germany as early as 1939. And though the

MESSERSCHMITT 163 (Komet) was the first German jet job to meet our flyers. Its rocket engine was good for only 22 minutes of "squirt" at best; it was kept in the air by sustained periods of gliding.



JET-PLANE TACTICS, as evolved by the Nazis, were governed by the limitations of the planes.





For example, the ME-163, with its very short range, was used in brief, darting attacks on our bomber formations. Its aim was to knock bombers out of line, to be finished off by prop-driven Focke-Wulf 190's.

Nazis lagged behind us in jet developments throughout the next two years, in 1942 they produced and flew several military prototypes. In fact, the strange death of their ace Ernst Udet is supposed to have occurred during the test flight of a German jet-propelled airplane.

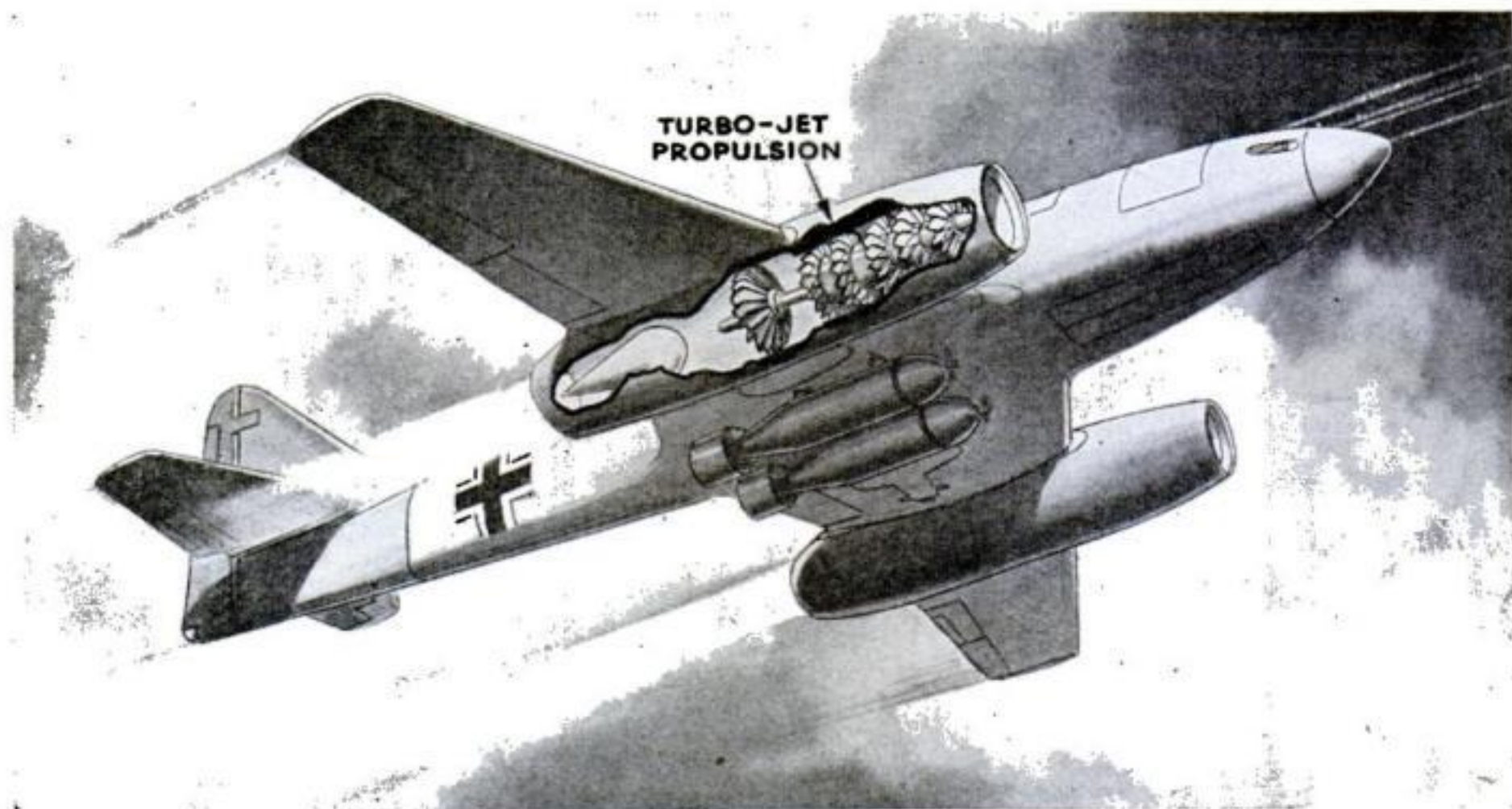
Had it not been for the Luftwaffe's early supremacy, it is quite possible that the Nazi jet would have made its combat debut much earlier. However, after the destructive battles of the spring of 1944, in which the German Air Force was rendered temporarily impotent, the High Command turned in desperation to the super-speedy jet in order to soften the impact of strategic bombing.

Consequently, there was little surprise when, on the very next day after the sighting of the first ME-163, a Mosquito pilot report-

ed an encounter with the even more formidable ME-262, a twin-engine jet-propelled aircraft. The Mosquito, no slouch when it comes to zip, appeared to be 100 miles per hour slower than the attacking jet.

The eventual appearance of these two basic jet types, the ME-163 and 262, nicknamed respectively the "Komet" and the "Blitz-bomber," evolved from the inception and parallel development of the rocket and the flying bomb.

For several years the Germans had used jettisonable rockets to assist take-offs of overloaded aircraft. Then, in 1943, they introduced the HS-293 glide bomb in the Mediterranean Theater. Powered by a rocket unit, this small, radio-controlled, pilotless aircraft was launched and directed by a parent plane. From the glide bomb to the



MESSERSCHMITT 262 (Blitz-bomber) used turbo-jet engines. Better than the Komet in everything except speed and climb, it proved a much more versatile plane. In an emergency, the pilot could catapult himself clear, along with the wide-vision cockpit canopy. Fuel tanks were housed in the wings.

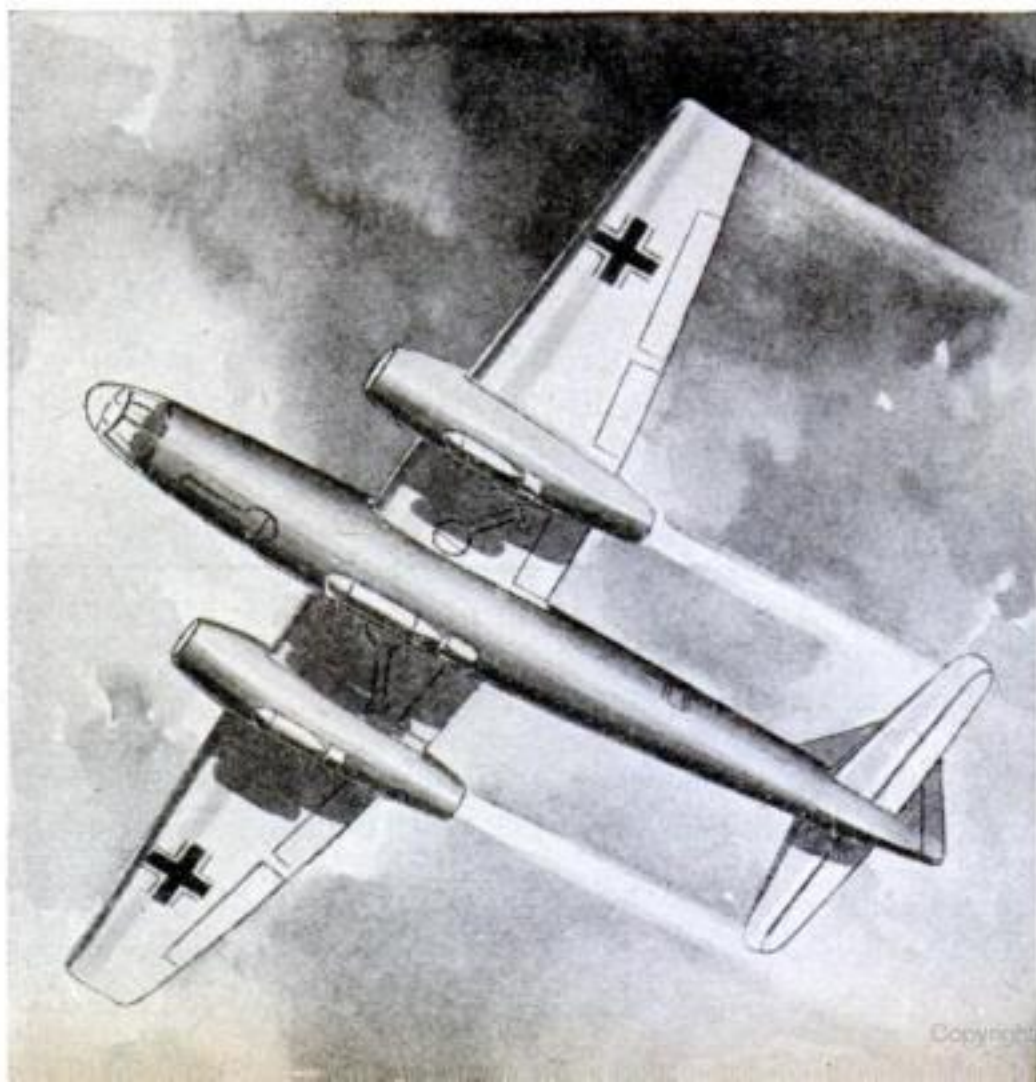
rocket-propelled ME-163 was a logical step. For both, the guiding principle is a closed unit in which fuel burns or gasifies. Rockets do not need air from the atmosphere for combustion. The gases leave through a nozzle at the rear, providing thrust by jet propulsion. Usable fuels include solids such as cordite; compounded liquids such as gasoline mixed with an oxidizing agent or liquid oxygen assisted by a catalyst; and a single liquid with or without a liquid catalyst—for example, hydrogen peroxide with potassium or sodium permanganate.

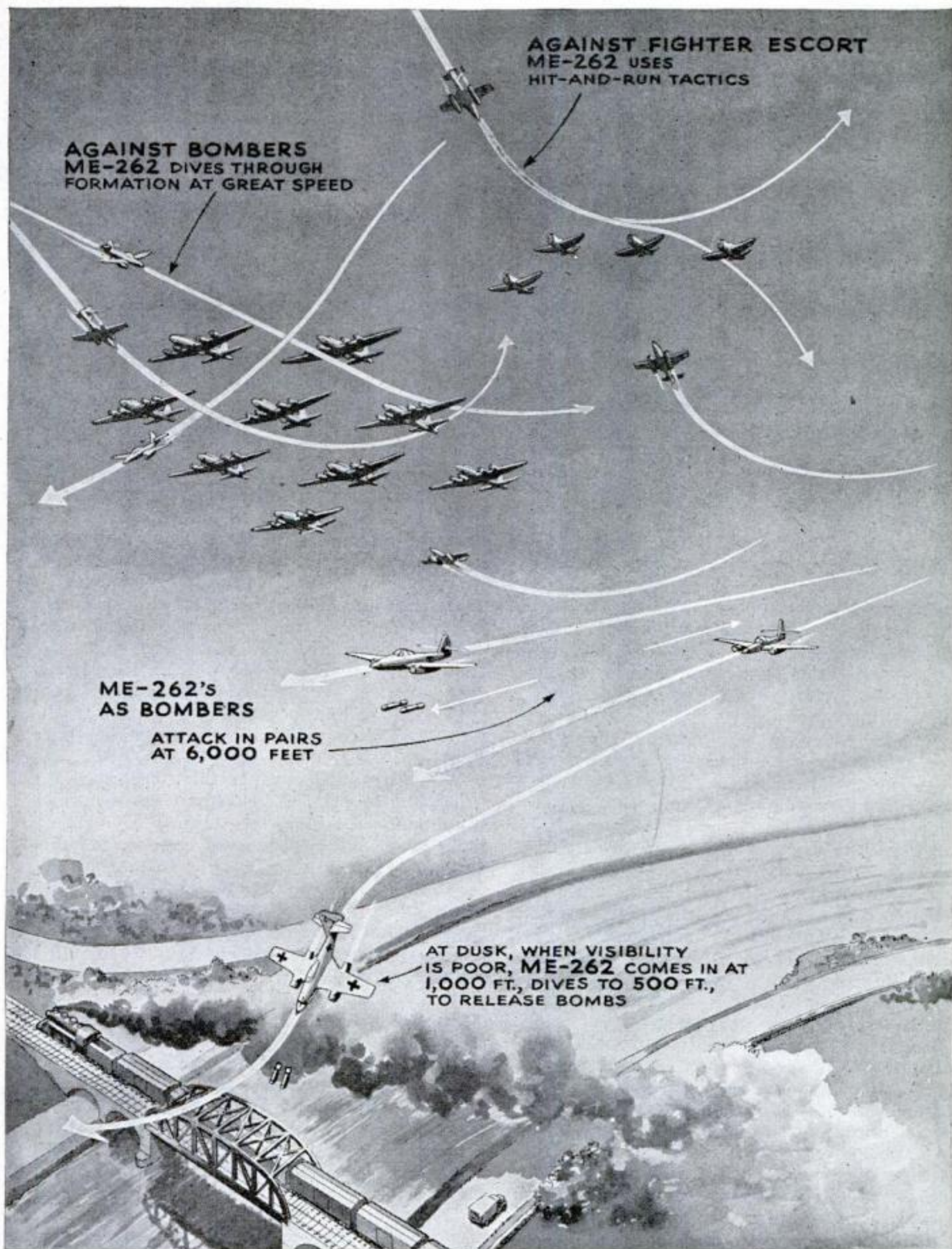
While the Nazis were perfecting the application of rocket propulsion to the "Komet," they also made great progress with the flying bomb. Unleashed in June 1944, this terror weapon achieved destruction within the London area. The flying bomb, which was the forerunner of the ME-262, exploited the principle of the "intermittent duct." Basically it consisted of an inlet valve, a combustion chamber, and a discharge nozzle. By means of an automatically operated valve located toward the front of the bomb, air entered the combustion chamber in impulses. Fuel was then injected and exploded, with the burnt gases

ejected toward the rear through a discharge nozzle. Such a device produces a thrust even under static conditions. A gyroscopic arrangement guided the flying bomb, while a timer established the duration of flight.

The turbo-jet unit of the ME-262, which appeared soon afterwards, utilized the intermittent-duct principle but mechanically compressed the air sucked in at the front of a duct. By means of injected liquid fuel the compressed air was then burned and expanded through a gas turbine which drives the compressor. Ejected, hot gases provide jet propulsion. *(Continued on page 204)*

ARADO 234 was the last Nazi jet plane to get into the fight. With slightly different turbo-jet engines from the ME-262, it had about the same armament and performance. Another turbo-jet job, the Heinkel 280, was used just once or twice and withdrawn.





TRIPLE-THREAT TACTICS made the ME-262 a troublesome customer. Carrying at least four 30-millimeter cannons in its nose and two 551-pound bombs under its fuselage, it was adapted to low-level bombing and strafing of Allied installations behind the lines as well as to lightning strikes at our bomber formations. Its heavy armor—15 millimeters thick in some places—enabled it to tangle with our fighters if necessary. When carrying bombs, it was slowed down so much that it sometimes took along its own fighter escort. Allied troops called it "the silent strafer" because it streaked past with little sound.

FROM STUNTMAN TO PARATROOPER . . .

How Armies Hit the Silk

Invented centuries before the airplane, the 'chute was still just a stuntman's toy at the end of the First World War. Now it saves countless flyers' lives, ferries weapons and supplies, and spills airborne troops from the sky to strike behind the enemy's lines.

By JAMES L. H. PECK

THE airborne forces that parachuted to earth beyond the watchers on the Rhine this spring mushroomed out of an idea that is older than Uncle Sam. The parachute was invented before the airplane, but, until after World War I, parachuting was mainly a showman's stunt, on a par with sword swallowing.

The French flyer who saw a German pop out of a burning plane and float gently into a storm of bullets in no man's land in 1917 was flabbergasted. His generation of airmen had felt that anyone who was seriously interested in ways of deserting his ship was a sissy.

But the parachute now ranks with the lifeboat, the first-aid kit, and the chariot as one of mankind's super-duper ideas. It is no longer a mere fire escape from the heavens for pilots; it can be used now to deliver almost anything that can be taken up in a plane. Electrically driven conveyor belts dump cargo bundles into thin air from some planes, and doors were cut in both sides of the C-46 Commandos that flew over the Rhine, so that two columns of paratroops could march out simultaneously and descend in double file.

Such surprising assaults from the sky stem from scientific research that was started during the last war—and continued after the Armistice.

Nearly five centuries ago Leonardo da Vinci drew a picture showing how a man with "a tent of calked linen" could "let himself fall from any great height without danger to himself," and between 1780 and 1800, when men began to go up in balloons, some of them came down this way.

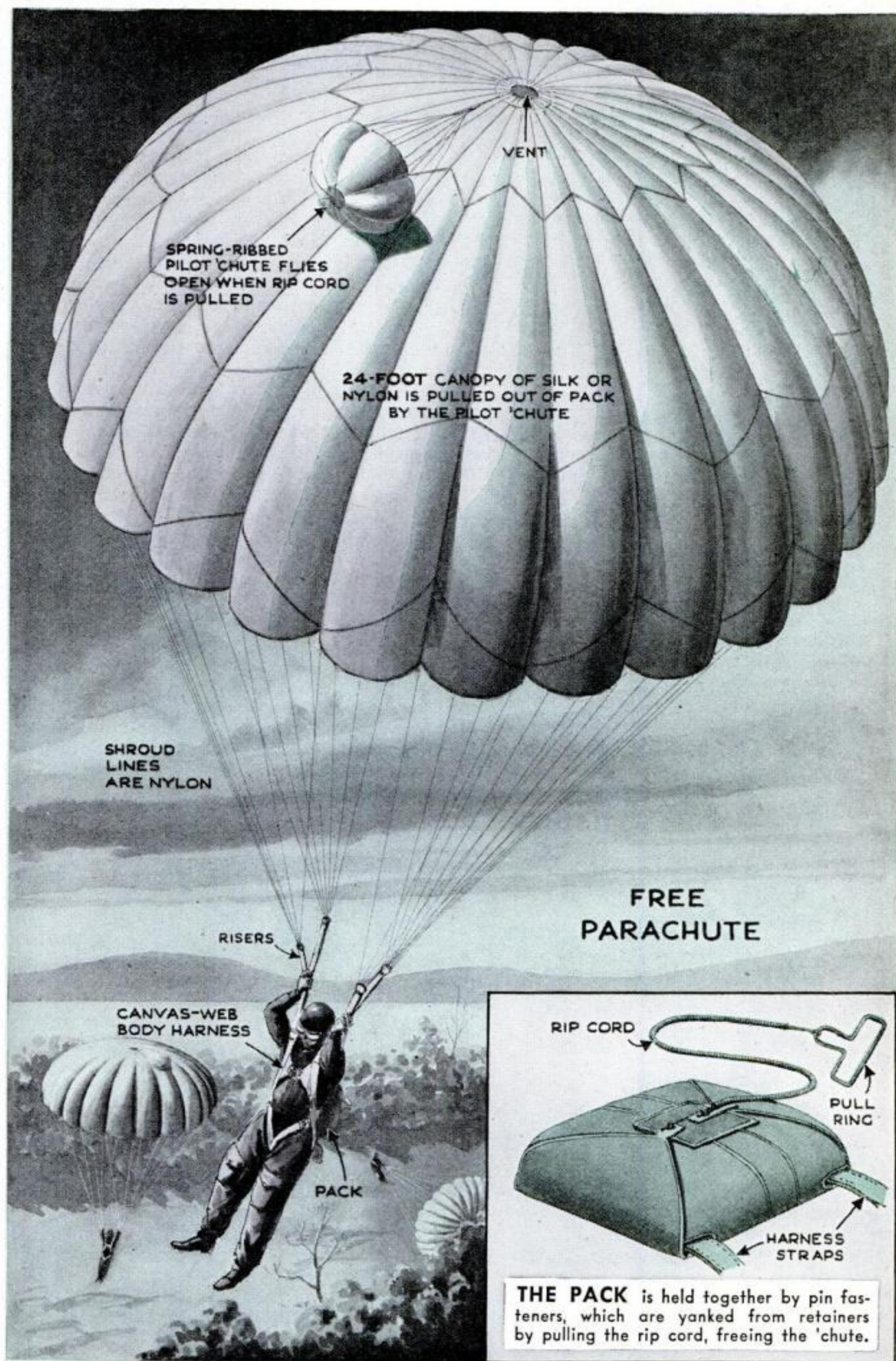
The first parachutes had rigid frames and were far from perfect mechanically. Professional daredevils devised nonrigid parachutes, beneath which they hung on trapeze bars. The speed of airplanes increased the hazards. Capt. Albert Berry made the first successful drop from an airplane in 1912 with a 'chute that had been packed in a metal cylinder under the plane's fuselage. But the First World War was over before any country had developed a 'chute that could be guaranteed to open on leaving an airplane.

Interest waned considerably when peace came, but Major E. L. Hoffman and a number of other Americans persisted. Leslie Irvin saw Houdini produce a huge flag from a tiny container, and thought of making a parachute out of silk and squeezing it into a small pack. Other noteworthy features of the parachute that he produced were a simple rip cord and a pilot parachute to pull out the main canopy.

"PLANE FAILED, PARACHUTE WORKED," Jimmy Doolittle happily wired the Irving Air Chute Company 14 years ago, after a thrilling escape from a damaged plane in the National Air Races. That four-word message was a climax to years of research, including more than 50,000 tests with dummies. And the same four words now summarize more adventures than there's paper enough to print.

The parachutes used nowadays are thoroughly reliable mechanisms. Both the "free"

SIMPLICITY is the secret of America's parachutes—the best in the world. Fighter pilots and bomber crews wear the free 'chute (right), while paratroopers use the automatic type, which is opened by a static line attached to their transport





1 RIP CORD is pulled as flyer clears plane; unless he is so high up that he must "free-fall" to get into denser air.

2 PILOT 'CHUTE pops open as it is freed from the pack. Its ribs spread it wide to catch the wind rushing past.

3 MAIN 'CHUTE drags out of the pack as it is pulled by the pilot 'chute. A jolt tells the airman when it is open.

4 NEARING EARTH, the flyer turns the 'chute to face forward. He pulls up on the risers to help break fall.

5 LANDING, he tumbles and takes the shock on shoulders and buttocks. If the wind is high, he frees 'chute.

FREE 'CHUTE IN ACTION. The drawings on the left show a fighter pilot using a seat-type free 'chute. Other types are worn on the back and chest. Flight conditions determine the safest way for an airman to leave a crippled fighter or bomber.

'chutes, used in emergency descents, and the "automatic" type, worn by paratroopers and pulled open by a canvas-web "static line" attached to the plane, are trustworthy conveyances. Unusual conditions and human errors still result in mishaps, but young pilots now are told emphatically:

"Don't take chances. Hit the silk if something goes wrong. We can build ten of these planes in the time it takes to train you."

This advice has been stressed because, even after airmen were ordered to wear parachutes, flyers persisted in an attitude comparable to that of sailors who refuse to learn how to swim. The importance of the know-how is better realized now. Well-trained paratroops have been injured in leaps only about one sixteenth as often as flight crews. Such statistics prompted the AAF Office of Flying Safety to wage an extensive educational campaign among air personnel in 1943, and brightly colored posters now hang in air stations to remind combat flyers of the correct way to descend beneath a blossoming awning.

To get out of a stricken, 400-mile-an-hour fighter with an enclosed cockpit, or a big, complex, misbehaving bomber, a man still may need luck as well as a cool head and technical skill. Most combat planes now are fitted with automatic door or canopy releases, some of which are spring-assisted and actually fly off. Bombers have escape hatches forward and aft, and the gaping hole of the bomb bay may be used in a pinch. But it pays 1945 candidates for membership in the Caterpillar Club to keep in mind "three A's":

Altitude: "Am I high enough to have time for the 'chute to open? Paratroops are dropped from low but carefully predetermined altitudes. If I'm very high, I must connect the oxygen bottle on my leg, or make a free fall until I reach 'breathing' air."

Attitude: "The best attitude for a bail-out is upside down. Can I roll the plane over and fall out? If the ship is diving, I must brace my feet lest I be thrown forward when I unbuckle the safety belt. If the ship is spinning, I'd better go out the correct side—toward the inside of the spin, so the tail will be swinging away from me."

Air Speed: "Will I be going 400 miles an hour when I leave the plane? That's too fast. 'Body speed' in a normal free fall before a 'chute opens is only about 125 miles an hour. Can I fall free until I have slowed down nearer to that speed?"

As he falls away, the wise parachutist



PARATROOPER'S AUTOMATIC 'CHUTE.

Skytroopers in a big transport hook the 15-foot static lines of their back packs to a cable in the carrier. This line automatically pulls the rip cord when the soldier has cleared the ship. A paratrooper (left) pivots on his left foot, turning toward the tail, to jump feet first. He also wears a reserve chest 'chute, which he opens manually if his back pack fails. Photo below shows both 'chutes open.

keeps his legs together to avoid tangling the harness and risers when he pulls the rip cord. A jolt tells him when the 'chute opens; if he finds himself swinging too much, he steadies the magic carpet above him by pulling at the shrouds on the high side of each swing. He then looks downwind for a likely landing spot, and grasps the shrouds to swing the 'chute so that he is facing the way the parachute is drifting. If trees or other obstacles loom in his path, he sideslips by pulling down on the shrouds on one side.

(Continued on next page)



TYPES OF PARACHUTES

BACK-TYPE PARACHUTES:



This B-8 pack is flexible. Opening three fasteners frees harness.



B-9 has single-point, quick-release harness.

TROOP-TYPE PARACHUTES: (Used by Paratroops)



Chest pack (A-3) is paratrooper's reserve 'chute; T-5 has the static line.

ATTACHABLE CHEST-TYPE PARACHUTES:



A-3 and A-4 can be donned quickly by bomber crews and Navy flyers.



These are best for fighter pilots. S-1 (above) has the multiple-release harness.

SEAT-TYPE PARACHUTES:



S-5 is the same, except for quick-release disk.

As he hits the ground, he pulls up strongly on the risers. He lands with his feet together and his body and knees slightly bent. He doesn't try to stay on his feet, but tumbles, taking the shock of the roll on his shoulders and buttocks. A man coming down straight, without oscillating, in a standard 24-foot parachute hits the ground about as hard as though he had jumped off an eight-foot wall.

If the wind is high, the well-trained parachutist unbuckles the harness leg straps before touching the ground, unsnaps the chest buckle the instant he lands, to free himself from the dragging 'chute. He takes pains, however, to save his 'chute if possible, by spilling the wind out and collapsing it as soon as he has landed—because a parachute is often as nice to have on the ground as in the air.

Stranded airmen have used their parachutes to make tents, clothing, bandages, slingshots, fish lines, snowshoes, and scores of other handy items. One sergeant, to attract the attention of planes searching for him, touched a match to the rubberized horsehair cushion of his 'chute, and the black column of smoke that it sent up led to his rescue.

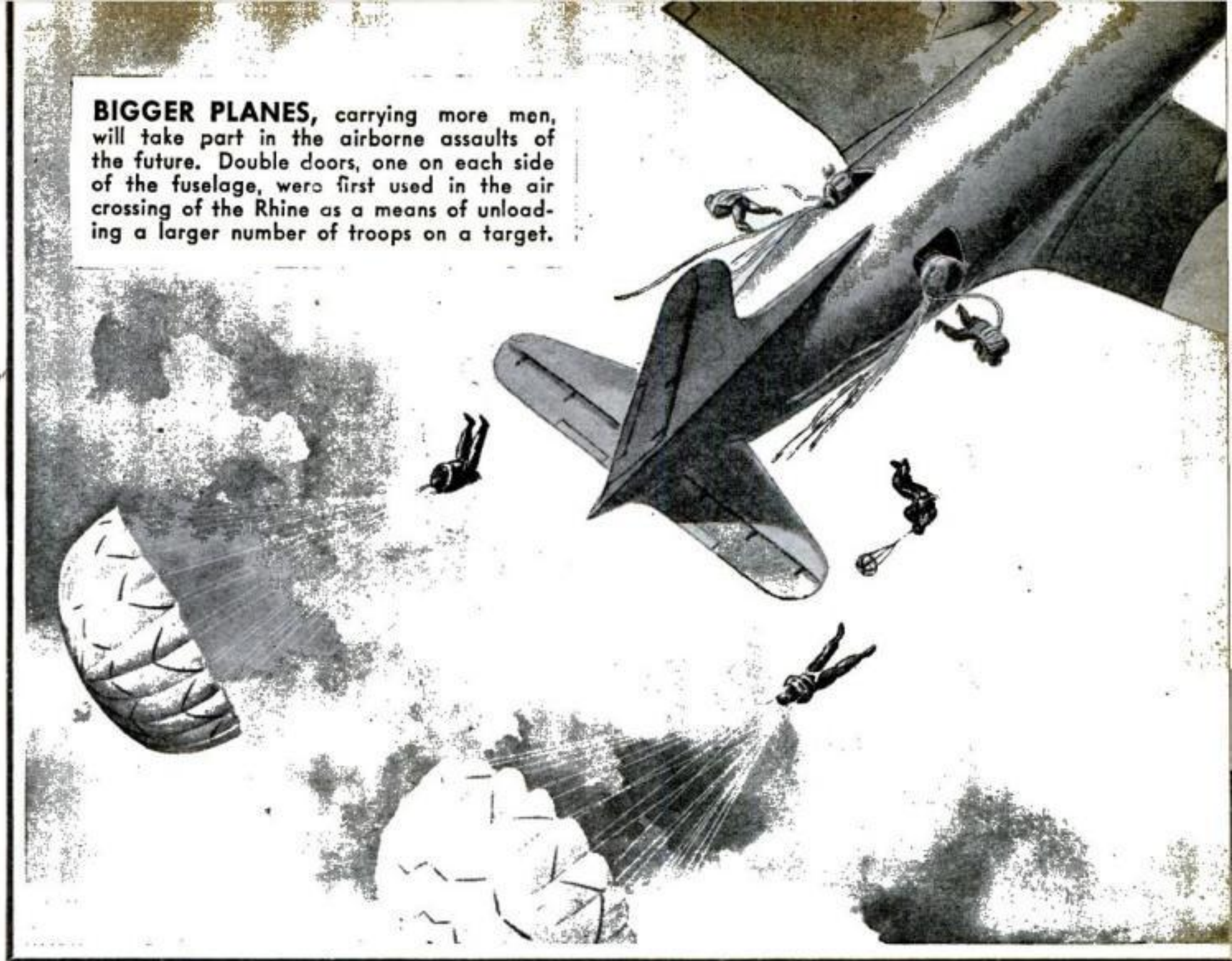
Pure silk parachutes are considered best,

especially in northern climes, and some are still being made in this country from Japanese silk bought before the war. But many parachutes now are made of nylon, or acetate fabrics such as celanese, milanese, or rayon. Cargo parachutes are made of mercerized cotton and rayon, and those for flares and fragmentation bombs of specially processed paper. Experts at the Parachute Laboratory of the Materiel Command at Wright Field, Dayton, Ohio, have developed dozens of different kinds and sizes of 'chutes.

Both seat-pack and chest-pack parachutes are available that can be attached to a man's harness by snap buckles in a jiffy. Bomber crews and Navy airmen wear the harnesses that go with these packs. They can walk around the whirling propellers on a crowded carrier deck, or move about inside a plane, without being encumbered with packs, yet can hook them on quickly when they need them.

Food and other necessities are stored in some modern military parachutes. The AAF B-4 Basic Emergency Kit is zippered into a canvas case which is attached to the 'chute harness in place of the back or seat pad normally worn for comfort. This outfit includes a feather-stuffed poncho-quilt, a folded machete, and a first-aid package as

BIGGER PLANES, carrying more men, will take part in the airborne assaults of the future. Double doors, one on each side of the fuselage, were first used in the air crossing of the Rhine as a means of unloading a larger number of troops on a target.



well as a small supply of emergency rations.

The Navy has a similar kit that may be substituted for the harness cushion, and also a pararaft for carrier pilots. The inflatable raft is made of rubberized nylon

and stowed in a small roll on top of the parachute pack. The raft is only large enough for one man, but has a protective cover and folded paddles.

Rescue planes can spill more food, medi-

1617. The first recorded parachute jump in history was made by an Italian who used the device designed by Leonardo da Vinci more than 100 years before. The 'chute was a square sail with cords tied to the corners.

1808. The first forced jump was made by Jordaki Kuparento, a Polish aeronaut, whose balloon caught fire above Warsaw. He made his escape from the basket beneath the burning bag and floated safely to the ground.

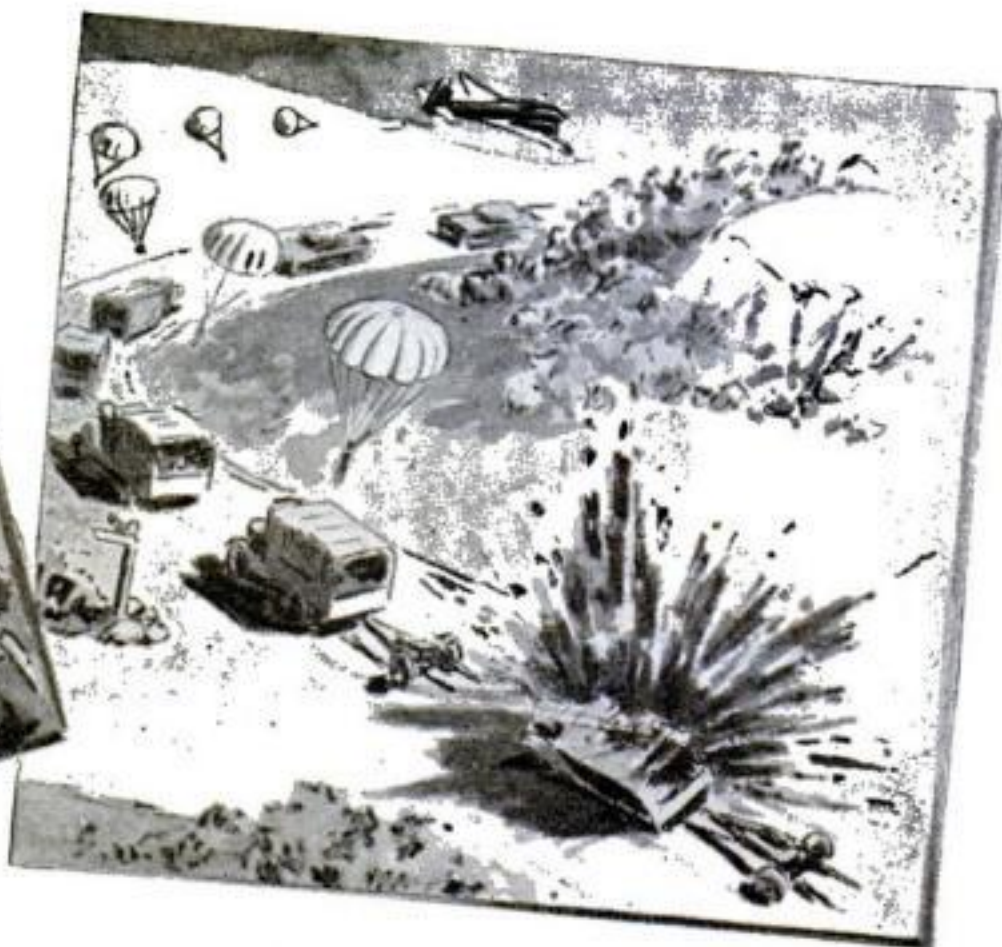
1912. Nine years after the airplane was invented the first successful drop from one by parachute was made by Capt. Albert Berry. His 'chute was packed in a cylinder under the fuselage





'CHUTE MAIL TO IWO.

Less than three weeks after the invasion, leathernecks on Iwo Jima were getting their mail dropped to them by parachute.



TREETOP BOMBING. Bombs dropped from tree-top level are attached to parachutes, to delay the bombs' fall and enable the planes to escape the blast.



SUPPLIES FROM THE SKY.

Parachutes deliver medicines, ammunition; also jungle, desert, and arctic packets to cut-off units. Colors distinguish these 'chutes.



RESCUE AT SEA.

Airborne lifeboats—27 feet long, 2,800 pounds—are designed for sea rescues. Powered by two five-hp. engines, craft do eight m.p.h.

cines, and supplies on men downed on land or sea. A Tropic Rescue Kit contains items helpful to men lost in jungles or deserts, and a Marine Rescue Kit has a canister full of supplies for castaways.

Our Army learned a lot about packaging and parachuting provisions from the U. S. Forestry Service, whose asbestos-clad "smoke jumpers" were being supplied by

parachute in fire fighting before the war.

Orange 'chutes are used in the arctic, and an orange flag pops up from some of the containers used, to help men find the supplies dropped for them. Other colors are used in the tropics and, to facilitate the recovery of parachuted cargoes from trees, a weighted line dangles from each bundle. This line is about 75 feet long and brightly



AT CORREGIDOR. Here are paratroopers pin-pointing on the Philippine fortress to assist our amphibious troops in driving the Japs from its caves. Brig. Gen. William D. Old, Troop Carrier Command chief, predicts "delivery of standard ground-force divisions—supplied, equipped, and reinforced by air."

colored, with a four-pound steel ball on one end to carry it through foliage.

The paratroops of World War II have given the most spectacular demonstrations of Leonardo da Vinci's theory, but they are still lightweights compared with other military forces. Brig. Gen. William D. Old, Commanding General of the I Troop Carrier Command, recently predicted "aerial de-

livery of standard ground-force divisions."

"The armies of the future," he warns, "will not be as concerned with the frontiers of enemy nations as with vital spots within the nation itself. Thus, entire air-transported armies may be landed in the heart of the enemy's homeland and wage their war from within—supplied, equipped, and reinforced entirely by air."



DON'T HURRY down to breakfast just because you're afraid the coffee will get cold. It stays hot until you're ready for it atop the combination toaster shown above. The unit is now on display only as a vision of things to come, but Midwest Factors Corp., of South Bend, Ind., makers of the device, promise to produce large quantities for postwar tables. The young lady is incidental to the demonstration.

What's New in Modern Living

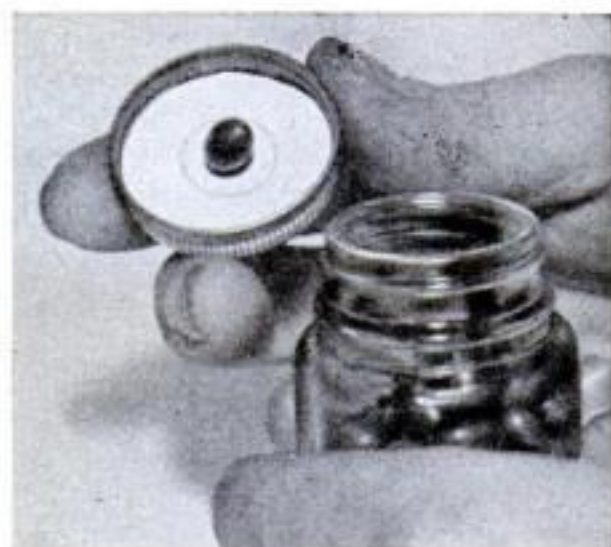
WHISTLE WHILE YOU WASH, or go and do your shopping. For 25 cents the Launderette does the rest. A Bronx, N. Y., store has installed 14 of the completely automatic coin-operated machines shown below. In a half hour each can turn out 10 pounds of laundry ready for ironing.



← **BLISTER BATHING** must have its points, to judge from the happy smiles that baby Jean Clair Bretherick, 18 months old, exposes to the camera. Her father, Homer I. Bretherick, an assistant foreman at the Bell bomber plant, Marietta, Ga., refused to be downed by the plumbing shortage. Unable to find a conventional tub in the war-crowded town, he acquired this obsolete B-29 gun blister from the plant's salvage store, where unusable material is sold to all comers.



CAPSULE CATCHERS, invented by K. Waring, of Forest Hills, N. Y., operate by means of a small adhesive area in the cap lining. Inverting the bottle before opening causes one or more of the pills to adhere to the inside of the cover, all ready for use.



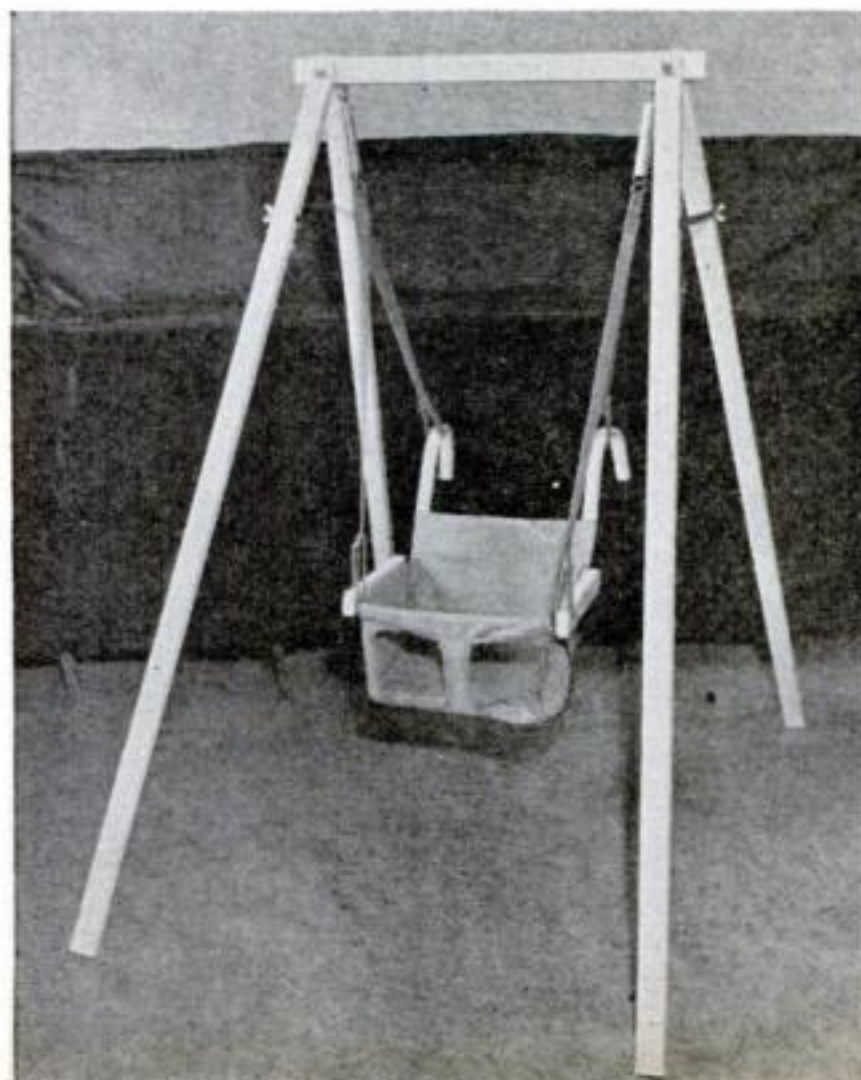
TROPICAL TOPPERS help stranded sailors keep cool heads and also protect jungle forces from heat and insects. They are made of vinylite by the Gallowhur Chemical Co., of Windsor, Vt. When deflated they can be stored in small lifeboat cupboards. For protection against the sun, they are blown up to the size and shape shown at the right, providing an insulated shade as well as protecting the neck and shoulders from bites. They are now available only for use by the armed services, but civilians are promised theirs soon.



← **COLD COMFORT** for food stores is promised by the "Frez-O-Mat" food dispenser which ejects single packages without exposing the refrigerator to warm air. Inventor Milton Rifkin's device displays up to forty-two items at a glance, thus eliminating frosty-fingered searching; it may be fitted with a coin mechanism to speed up self-service marketing. A barrier expels one package while shielding the interior from outside heat.

BYE-BYE BABY and don't cry, because this time you're going to travel in solid comfort. The metal-framed baby seat pictured below not only hangs from the swing stand, but can also be hooked over the front seat of an auto for easier and safer riding. It is made by the Collapsible Crib Co., of Los Angeles.

MOBILE IRONING KITS, containing all the ingredients needed for a professional pressing job, are ideal for girls living in small quarters or frequently on the move. On sale at Lewis & Conger, New York, each kit includes a 28" collapsible board, a press mit for the hard-to-get-at folds, a chemically treated cloth for imparting a lustrous finish to a fabric, a tin of grease and spot remover, and a sponge for dampening wrinkles.



Gus Makes a Quick Comeback

By MARTIN BUNN

JUST after Joe Clark had opened the Model Garage office one morning, Doc Marvin telephoned him that his partner Gus Wilson had the flu.

"What!" Joe yelled. "Gus sick? You're kidding me, Doc! Gus has never been sick a day in his life When will he be in—tomorrow?"

"No, he won't be in tomorrow, or the next day," Doc said. "He'll be all right in a day or so, but to be safe I'm keeping him in the house for a week—if I can. Right now he's worrying his head off about the shop."

"What's he worrying about?" Joe demanded belligerently. "I'm here, ain't I? Where does he get the idea he's the only one can keep this business running?"

The result of his psychology caused Doc to grin. "That's just fine!" he said heartily. "Why don't you stop in on your way home this afternoon and tell him that? It'll relieve his mind."

Doc wasn't a bit worried about Gus's condition, but that evening he went in to see him. He found his patient in a decidedly bad humor.

"What's this Joe Clark was telling me about you wanting to keep me cooped up for a week?" he wanted to know. "I feel fine right now, and tomorrow morning, so help me, I'm—"

Doc slipped a thermometer into his mouth. "Tomorrow morning," he said, "you're going to stay in bed. Look here now, Gus—when I bring my bus into your shop, I don't try to tell you how to do the job, do I? No, siree—I give you credit for knowing your business. Well, now, you

give me credit for knowing my business." He withdrew the thermometer, looked at it for a deliberate second, and began swabbing it off slowly with alcohol-soaked cotton. "That's only fair, isn't it?"

"Well, if you put it that way—oh, all right," Gus agreed unwillingly. "But it scares me when I think what's going to happen in the shop—with a guy who's a swell bookkeeper running things, and a grease monkey doing the work . . . I tell you, Doc, there'll be so much grief around the Model Garage when I get back that a week of rest in bed is going to be a total loss!"

GUS growled and grouched every day, but Doc had his way, and it was a full week before Gus got out of the house. Then he made a beeline for the Model Garage. He fully expected to find the shop in an unholy snarl and, feeling full of pep after his enforced vacation, he rather looked forward to untangling it.

Barely pausing to say hello to Joe Clark, he hurried into the shop. To his surprise he found no more than the usual number of cars on the floor awaiting attention, and Stan Hicks, busy over a bench job, was whistling cheerily. The grease monkey greeted him with a delighted grin.

"Gee, boss," he said, "I'm glad you're back!"

"That's all right," Gus told him with an attempt at casualness. "You've done a swell job keeping things going, and it was only to be expected that you'd run into some grief. We'll soon get—"

"Grief?" Stan interrupted. "We haven't run into any grief. Everything's been as smooth as cream. What I meant was that I'm glad you're back because it was lonesome."

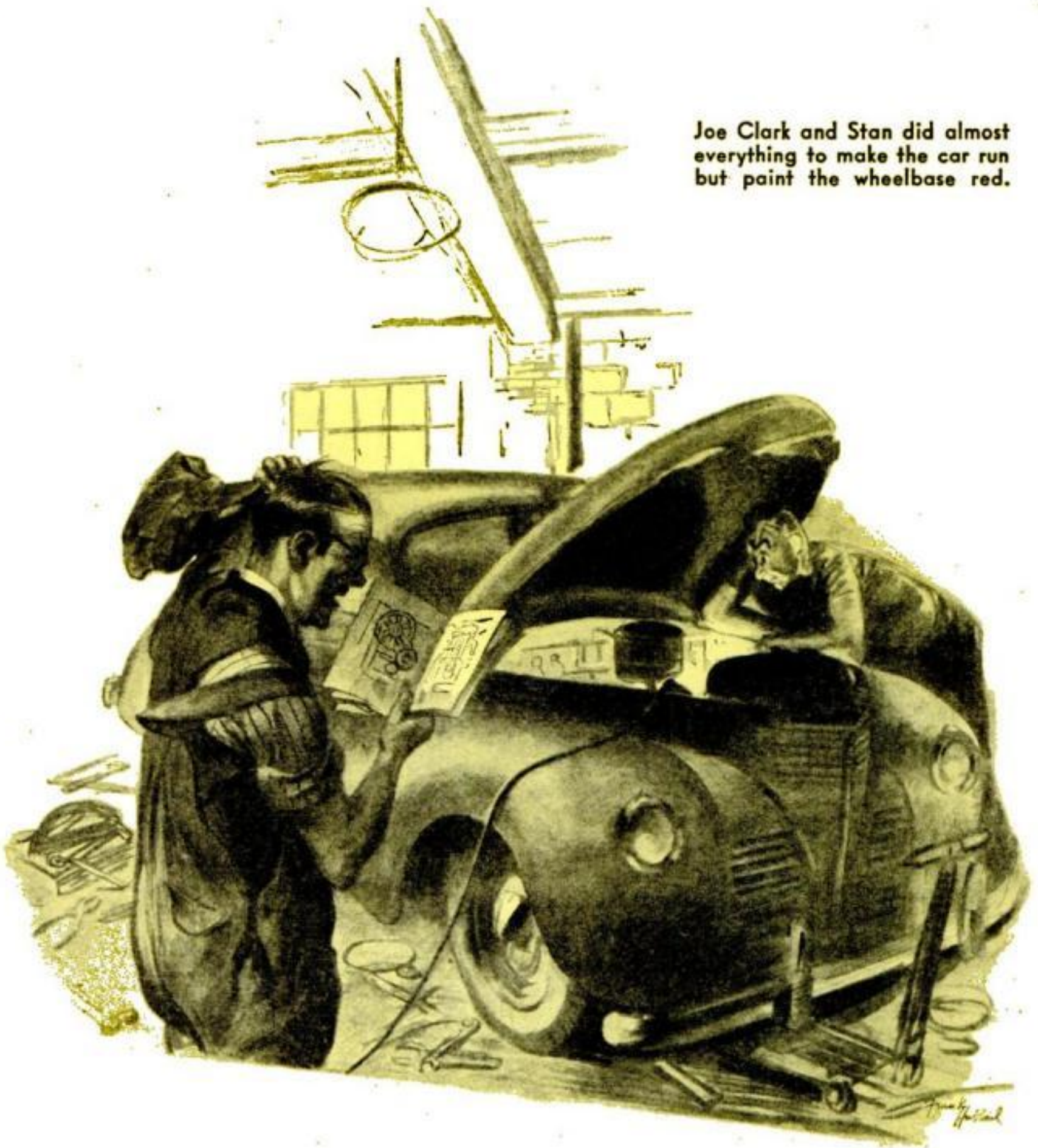
"Oh, I see," Gus said. A horn sounded at the gas pump. "You go ahead with what you're doing. I'll take care of it."

It was Mrs. Miller. "Oh, Mr. Wilson, it's so nice to see you back!" she gushed. "Not that Mr. Clark and Stan haven't done wonders—why, there was something the matter with the differential or universal or something or other on my car, and Mr. Clark diagnosed the trouble and

Gus stayed in bed a full week, as Doc ordered, but he growled.



Joe Clark and Stan did almost everything to make the car run but paint the wheelbase red.



Stan fixed it in a perfectly *marvelous* way. I told Henry that I think you deserve *loads* of credit for training that boy to do work as well as you do it yourself!"

It went on that way all morning. One regular customer after another came in, said he was glad to see Gus back, and then told him about some job that Joe and Stan had taken care of. Gus noticed that all had been simple jobs, but nevertheless when he went down to the Park House for his lunch he was feeling considerably deflated.

"It just shows," he told himself a little ruefully, "how a fellow builds himself up to himself until he begins to think he's the whole works—until something shows him that he isn't."

By the time he had finished eating he was

feeling so little needed that he put in half an hour reading the newspaper in the lobby instead of hurrying back to the shop in his usual fashion. While he was still busy with his paper, Jim Fraser, who owns our town's leading candy store and ice-cream parlor, plumped his 280 pounds in a chair beside him.

"Back on the job, huh?" Fraser wheezed. "I'll say it's about time! I've been waiting for you to show up to bring my car back after the bum job your place did on it while you were sick."

Gus experienced a pleasurable sort of mental glow, but he didn't let Fraser know it. "What's the matter with your car?" he asked innocently.

"Nothing," Fraser told him sarcastically.

"Nothing at all—except that it burns twice as much gas as it ought to, and that when I try to drive it over 20 miles an hour it's got all the pep and punch of a wet dishrag. Now, understand me—I'm not claiming that that dumb partner of yours and your dim-witted helper did it any harm. What makes me sore is that they nicked me six bucks for not doing it any good. I ain't satisfied, Gus—I really ain't!"

"Well, I can't blame you for that," Gus conceded. "I saw your bus outside, Jim. Let me drive it back to the shop."

Joe and Stan winced when they saw Gus arrive in the four-wheeled headache, but Gus repeated Jim Fraser's beef in the most natural tone he could muster. "What did you do with it, anyhow?" he concluded.

Stan grinned and looked at Joe. "We did almost everything except paint the wheel-base red," he said.

Joe looked sheepish. "To tell the truth, Gus," he confessed, "that job sort of had us stumped. We just couldn't find out what was the matter. We checked and rechecked everything we could think of, and cleaned the motor and tightened up the wiring connections, and so on. It seemed to run a little better after that, and because Fraser was calling me up about every hour, we gave it back to him."

Gus snorted. "How the dickens did you ever figure you could fix a car up before you even knew what was the matter with it?" he demanded.

He started the engine and listened intently for a minute. It ran smoothly. He went over the carburetor and fuel pump carefully without finding anything wrong with either. Then he checked the spark plugs; they were all right—and so was the point setting.

"Let's have the vacuum gauge, Stan," he said. He attached it, and found that it registered between 20" and 21" of vacuum at idling speed—which was just perfect. But then he took the car out on the highway and discovered that Fraser was dead right—that at speeds over 20 miles it was noticeably sluggish.

He drove slowly back to the shop, got out his Neon timing light, attached the ground lead near the flywheel housing, clipped the other to the No. 1 spark plug, and whitened the ignition-timing mark on the flywheel with chalk. Then he started the engine, and as the light flashed he watched the chalked mark, which appeared to be standing still in line with the timing pointer on the flywheel housing.

"Speed her up," he told Stan after half a minute. Stan opened the throttle—and the white mark appeared to be to the right of the pointer.

"Switch her off," Gus ordered. "It's what

I thought—the timing is all right at low speeds, but it's slow at high speeds. That makes the cylinders fire on the down stroke of the pistons, which results in loss of power and waste of gasoline. The automatic-advance governor in the distributor must have gone haywire."

HE took the distributor apart, expecting to find the automatic-governor weights rusted and stuck. To his surprise they weren't—and all the other parts in the distributor seemed to be in perfect condition. He cleaned them carefully, reassembled them, replaced the distributor, and retested it.

The timing still was correct at low speeds—and still late at high speeds!

Gus muttered under his breath, took the distributor apart again, inspected all its parts, reassembled them, put the distributor back, and again tested it. The result was the same!

This time Gus expressed himself out loud. Then he lit his pipe and did a few minutes of hard thinking.

"That's it," he said. "Can't be anything else . . . Hey, Stan! Give me a hand. We've got to rip this engine apart!"

They ripped it apart until they could get at the timing gears. Gus examined them and nodded. "That's it," he told Stan.

"What's it?" the grease monkey demanded in an injured voice. "It's past quitting time, and I dunno what we're doing on this job, or why!"

"Take a look at those timing gears."

Stan looked at them. "They look a little worn," he said.

"They're badly worn," Gus corrected him. "That's the cause of the trouble. Ever hear of torsional vibration?"

Stan grinned. "I ain't read that far in the book."

"Well," Gus said, "it's a sort of twisting vibration that occasionally causes plenty of hard-to-locate grief. In this particular case it keeps the automatic-advance governor from advancing the spark as the speed of the car is increased. That's why this bus hasn't had any pep and has been burning up Jim Fraser's gas fast . . . We'll have to put in new timing gears, and that'll be quite a job. How do you feel about a little overtime this evening?"

Doc Marvin, passing the Model Garage about 11 o'clock, noticed the lights and went in. He found Gus washing up.

"By George," he squawked, "I might have known it! Didn't I tell you that the only way to get over flu is to take it easy?"

Gus grinned. "Flu?" he said. "Honest, Doc, I forgot all about it. There's nothing like a good tough trouble-shooting job to help a man make a quick comeback!"

HOW GOOD ARE SYNTHETIC TIRES?

**Better than you may think.
Army mileages suggest tires
may outlast the postwar car.**

By HAL BORLAND

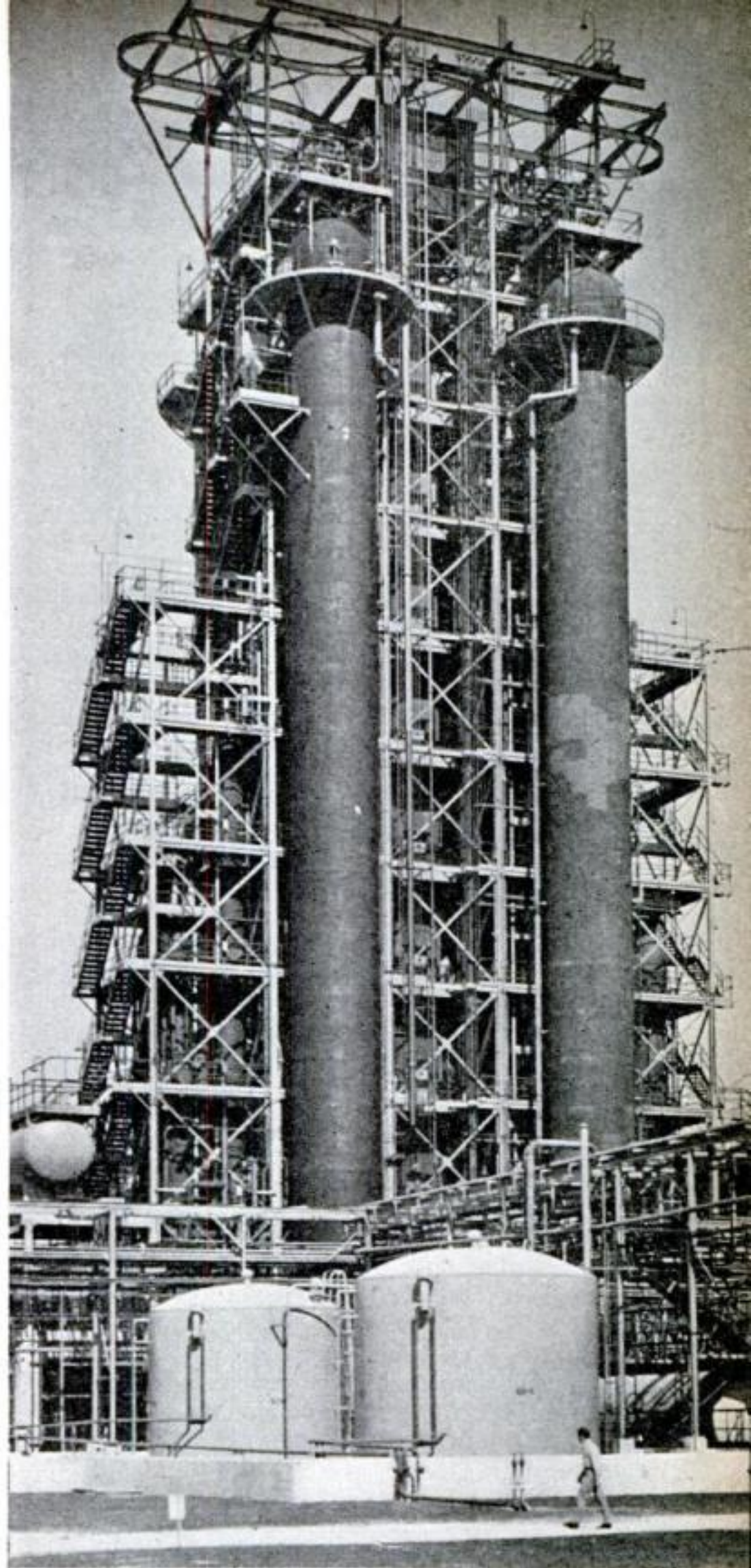
A MERICAN motorists, many of whom have been running on synthetic rubber for some time now, are going to get synthetics not only on their first postwar cars but probably on most of their cars for a long time to come. This, in case there is any question about it, is good news. To take only one angle, those who know most about such things are now talking seriously about synthetic tires that will not only be punctureproof but will last as long as the car. And that's just part of the picture.

Last year America's plants turned out a greater tonnage of synthetic rubber than we ever imported of natural rubber in any one year. Our production capacity is still rising. So is the quality of the synthetics. The plants that fabricate this man-made rubber into tires and other essential articles have solved their really tough problems. And those who know costs say that synthetic rubber can now be produced for 15 cents a pound, possibly for several cents less. That brings it down to where it can compete with natural rubber on a price basis.

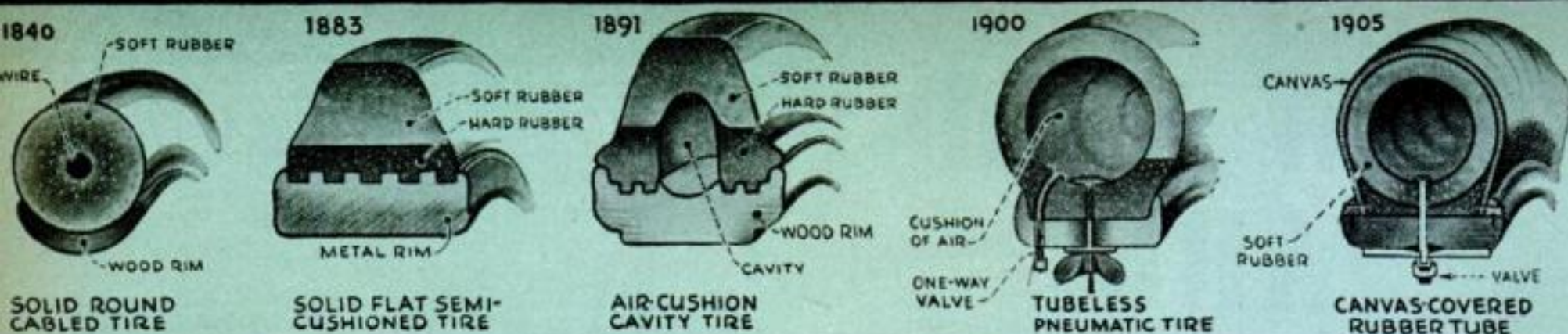
This doesn't mean that natural rubber is out of the picture. It has, and will continue to have, its place. But synthetic has already developed to a point where it has qualities natural rubber lacks. And, most important for the immediate postwar years, there isn't going to be enough natural rub-

ber to meet the needs of the world when this war is over. So, if for no other reason than necessity, synthetic rubber must remain in the picture. But there are other reasons, and good ones.

There are many types of synthetic rubbers. All are plastics having qualities simi-



Styrene, essential for buna-S rubber, is distilled in this towering plant of the Monsanto Chemical Company at Texas City, Texas. Buna-S is the synthetic rubber that has proved itself in the field on Army vehicles.



lar to rubber. Various types have a considerable range of characteristics, and the qualities of any one can be altered during manufacture.

The great bulk of our synthetic rubber is buna-S, also known as GR-S, the GR standing for Government Rubber. It is made from butadiene and styrene, which in turn are made from petroleum, petroleum gases, and grain alcohol. Buna-S is a general-purpose rubber that can be handled much like natural rubber. It makes good tires, excellent tires when used with a rayon or nylon carcass. Virtually all the tires on our military vehicles are made of buna-S. The uncompromising test of action in the field has proved its quality on literally millions of military vehicles.

Butyl rubber, GR-I, comes next on the list. It is made of isobutylene, a by-product of petroleum cracking. Though it, too, could be a general-purpose rubber, it has special qualities that set it apart. It is highly impermeable to gases and vapors and particularly resistant to deterioration with age. Butyl inner tubes—in the best grades now available only for the Army—are better than those made of natural rubber.

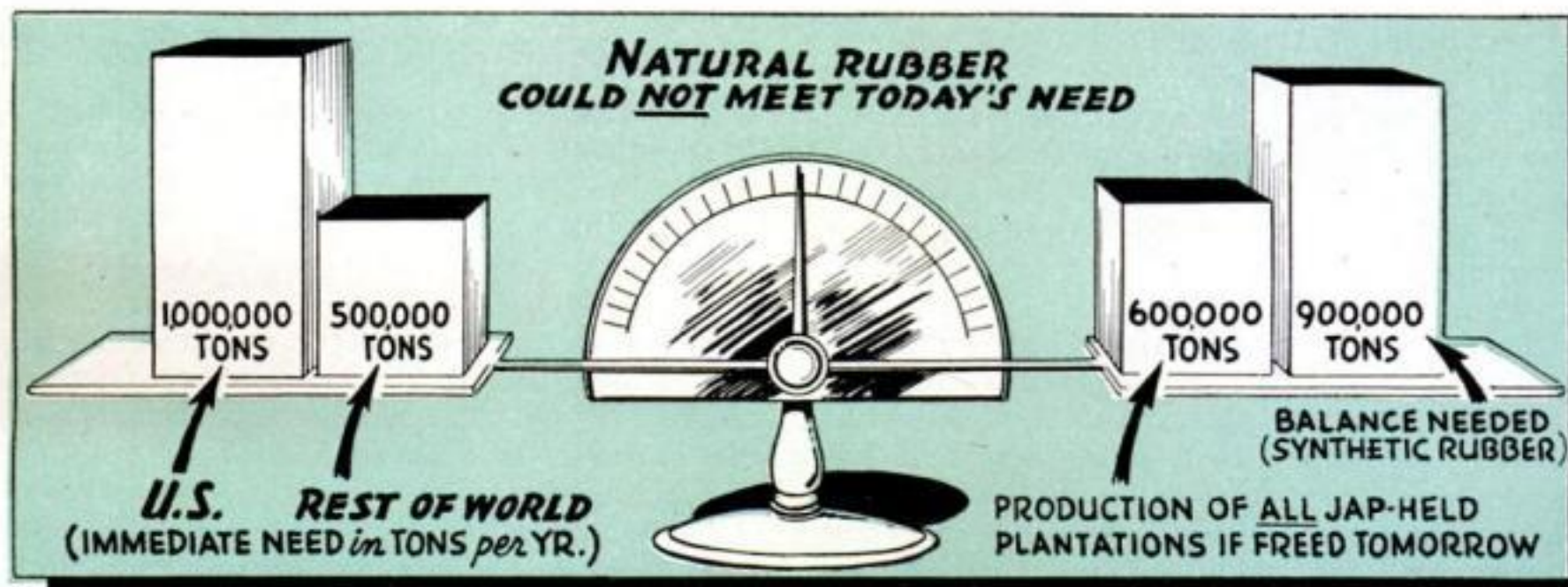
Neoprene, GR-M, was our first really successful synthetic rubber and had made a place for itself before the war. It is made of chloroprene, which is in turn made from coal and limestone. Because it costs more to make than buna or butyl, it is mainly used in special applications. It is particularly resistant to oils, chemicals, heat, air, and light. Also, it is almost flameproof.

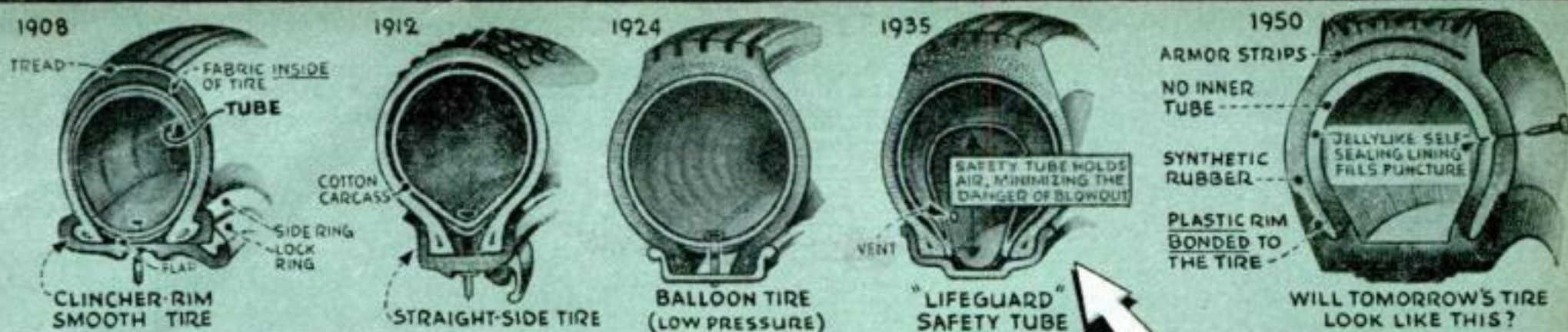
And there is buna-N, GR-N, another specialty rubber. Its manufacture is much like that of Buna-S, but its basic materials are butadiene and acrylonitrile instead of styrene. The cost is greater than that of buna, but it has unusual resistance to aromatics and other solvents. It is used primarily for fuel lines and fuel-tank linings.

There are other synthetic rubbers, and there are variations within the groups cited; but these indicate the particular types now available and being manufactured and used in quantity. They have been steadily improved ever since production got under way, and still further improvements are sure to come out of wartime experiences in both production and use.

The first "synthetic" tires were compromises. Most of them had natural rubber in the carcass and synthetic treads. Rigorous tests of these in small sizes—6.00 by 16, for example—showed good performance. In medium-truck sizes, however, the treads chipped and cracked; in heavy-truck sizes, they broke down under heavy loads and long hauls.

Then all-synthetic tires were made and tested, and they, too, broke down under severe conditions. They generated too much heat, and the cotton carcass couldn't stand up. Finally tires were made with carcasses of rayon and nylon and all-synthetic rubber. Meanwhile, the fabricators had learned a good deal about handling the synthetics and the chemists had found ways to beat the tendency of synthetic treads to crack and chip. These new tires really could take





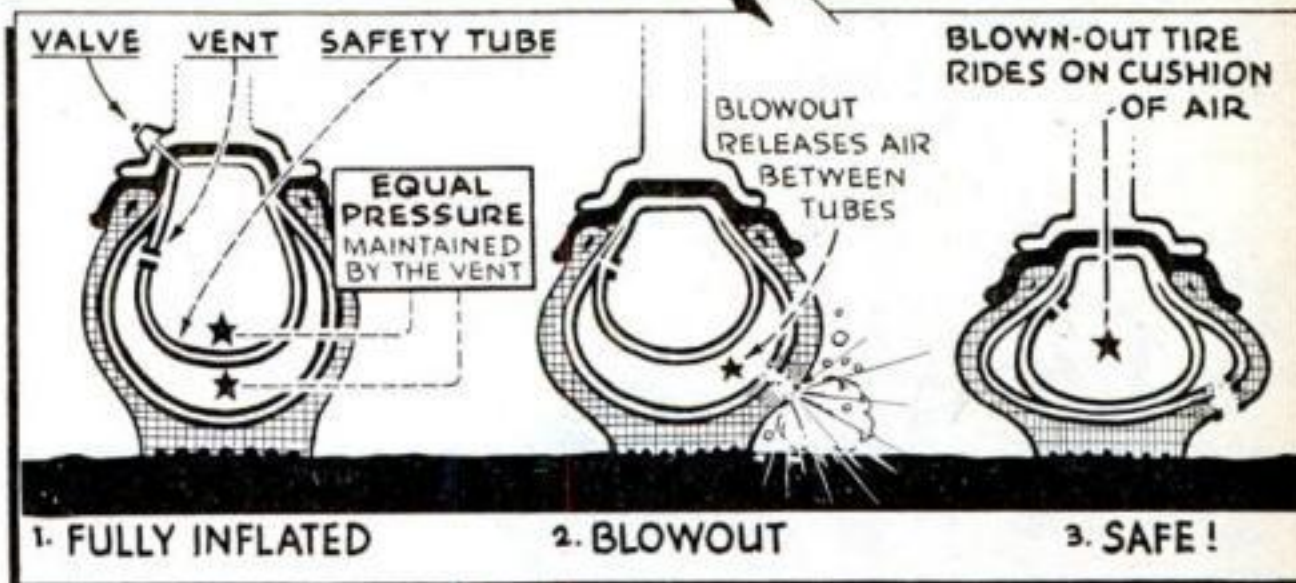
it. They gave performance under the most strenuous conditions that topped the best records of cotton-carcass natural-rubber tires. And the new synthetic treads gave considerably better wear than natural rubber. Where earlier tires broke down at 5,000 miles when run at 50 miles an hour with 20 percent overload, the new ones took a 30 percent overload 37,000 miles at 60 miles an hour before failure. And in a test of tread material, synthetic tank-tread blocks lasted half again as long as similar treads of natural rubber.

Performance of rayon or nylon and all-synthetic rubber tires in small sizes on such vehicles as jeeps and light cars—the size that will be used by most motorists—has been phenomenal even under extreme abuse.

Rubber men say they would have been pleased, but not satisfied, if they had achieved synthetic tires with as much as 75 percent of the life of natural rubber. They were, after all, working with new materials and had to devise new methods. And they point out that it took 20 years to progress from a natural-rubber tire that gave 7,500 or 10,000 miles service to the prewar tire good for 30,000 to 40,000 miles. Now, in about three years, they have built synthetics that excel the best natural rubber tires.

Bigger things lie ahead. The picture is something like this:

By using the best nylon and rayon cords for the carcass, it is possible to build tires good for 100,000 miles of passenger-car service. Nylon and rayon do not break down as cotton does under the sustained heat generated in a tire under

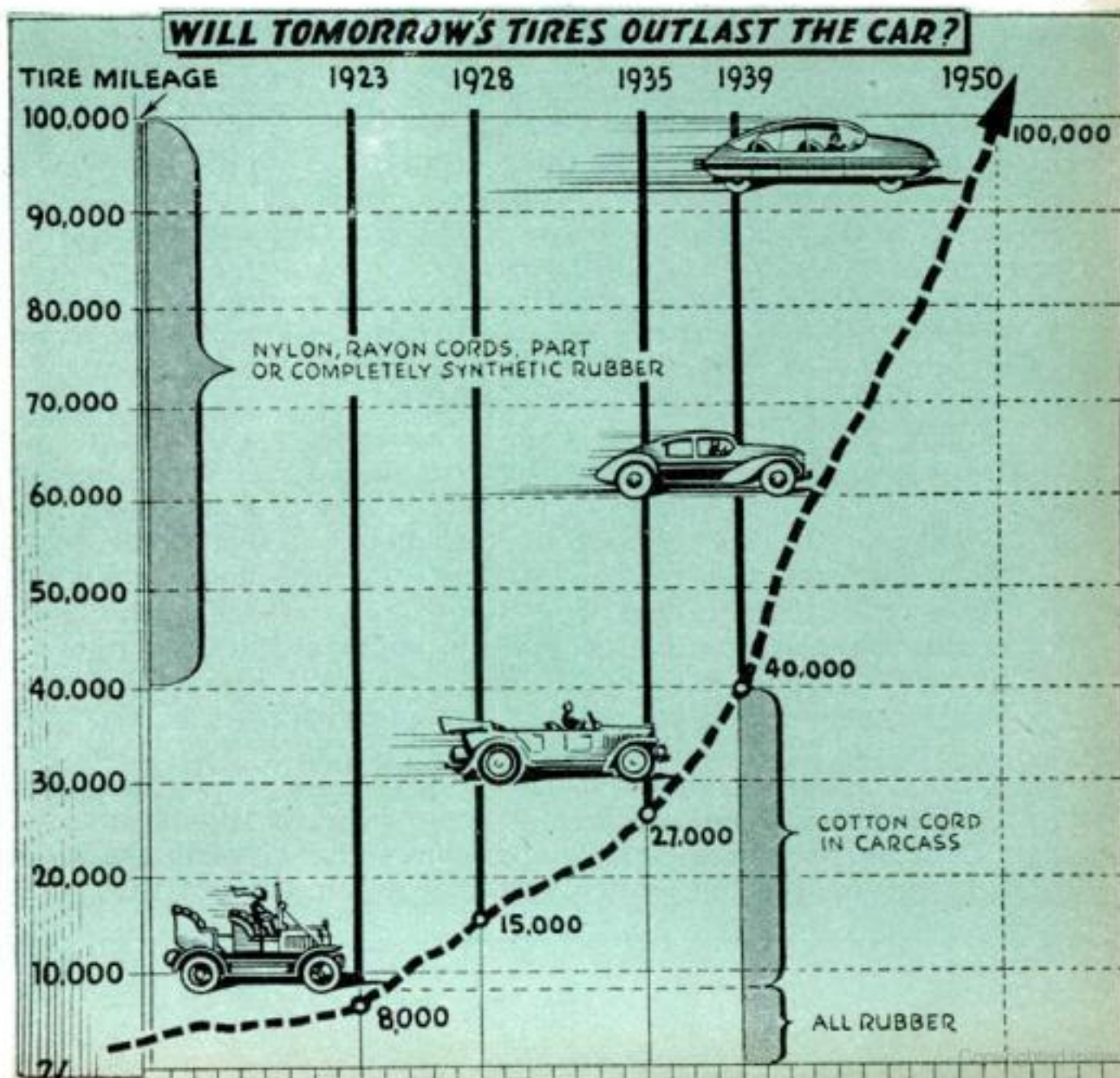


With this kind of tire, in use even before the war, blowouts held no terror. The safety tube provided time to bring the car to a stop.

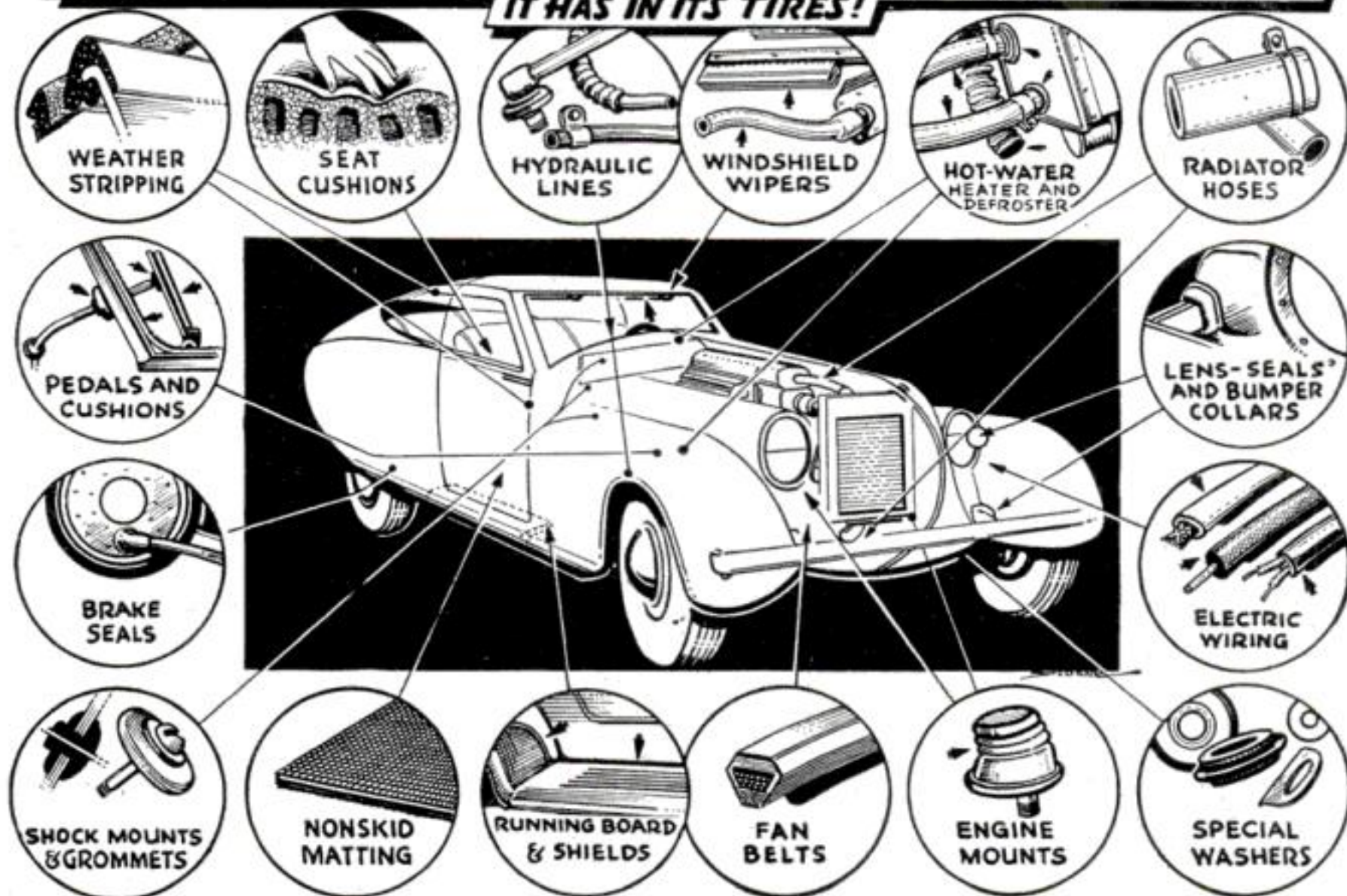
high-speed or heavy-duty strain. That heat is the principal enemy of long tire life.

Synthetic rubbers now available for tire carcasses will stand up as long as the nylon or rayon. They are, in fact, more resistant than natural rubber to the deteriorating effects of heat, cold, air, and sunlight.

Synthetic rubbers now in use provide treads good for 50,000 miles. Even better rubbers can be made, rubbers that will stand up considerably longer. But with ex-



THE MODERN CAR HAS A GREATER VOLUME OF RUBBER IN ITS BODY THAN IT HAS IN ITS TIRES!



isting treads of the best quality, a 100,000-mile carcass would be good for its full life with, say, one retreading.

Inner tubes made of butyl rubber will easily last the life of the tire, and there is serious talk of tires with the tubes built into the casings. They would be puncture-proof, like bulletproof gasoline tanks, except for major gashes such as long fabric cuts made by broken bottles. It is even possible that they may not have valve stems, being air-sealed at the factory.

Such developments, naturally, would mean fewer tire replacements. That would create economic complications. One solution would be to lease the tires instead of selling them—to sell tire mileage instead of tires. Fundamentally, this is not a new idea; owners of taxi and truck fleets have been buying tire mileage under such an arrangement for quite a while. But this plan would apply to literally millions of passenger cars.

That is the major part of the picture. There is also the matter of new engine types with sealed cooling systems. That would make it possible to run the engines at a considerably higher, and more efficient, temperature. Rubber enters the picture here in the form of hoses and flexible joints. Natural rubber cannot take 250 to 300-deg. temperatures. Some synthetic rubbers can.

Higher pressures and temperatures are also expected in lubrication systems. Again,

synthetic rubbers enter the picture. The same with fuel systems, possibly with high-pressure fuel injection. And for engine mounts, vibration dampeners, and torque checks, synthetic rubbers also have a place.

New gaskets will be essential with the higher pressures expected in new motors. Again, the synthetics will probably solve the problems. One type of synthetic rubber is being used today for high-pressure airplane gaskets, the rubber molded around a skeleton of copper mesh.

Synthetic-rubber bearings have been used with success. Special synthetics have high resistance to wear and abrasion and stand up extremely well under a constant oil bath. Experience in developing bearings for propeller shafts in combat boats that give bearings excessive use may be of assistance in this field.

There are dozens of other uses—for insulation of the electrical system, for fan belts, for hydraulic hoses, for windshield, door, and window strips, for battery cases, for seat cushions. And for each of these uses there is a synthetic rubber that will do the job as well as natural rubber.

The big future, however, seems to be in tires. That was the big problem we faced when the natural-rubber supply was cut off. It was solved brilliantly, and the solution is opening a whole new vista for tomorrow's motorist.

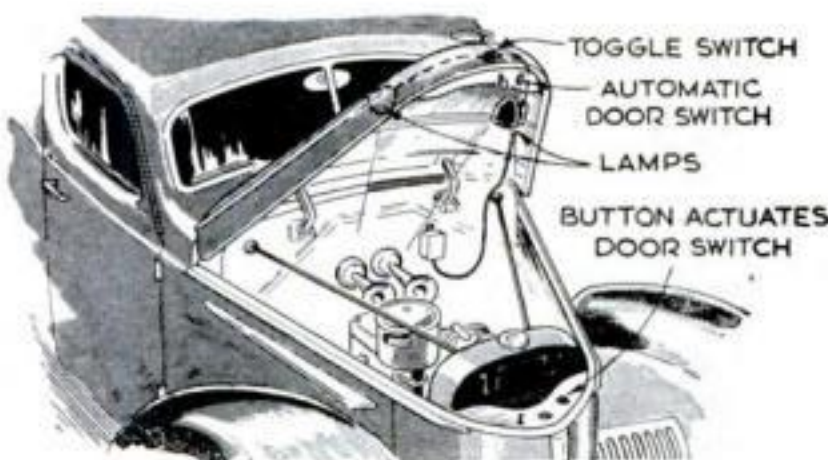
SAFETY LIGHTS that fit into the front fenders of a car, as shown in the photos below, throw light on one of the darker sides of driving. By illuminating the road on either side, they make it easier to judge clearances, give other cars a clearer view, cut through rain and mist, and aid in changing tires. By making a car readily visible from the side, the lights eliminate one cause of nighttime accidents. They are made by the L. D. Bridge Company, of Blairsville, Pa.



ELECTRONICALLY CURED rubber and rubber products have been produced as much as 17 times faster than is possible by the use of the conventional steam method. This new way of vulcanizing rubber has reached the production stage at the Firestone Tire



TROUBLE SHOOTING at night is no longer a problem for William C. Webb, Jr., of Darlington, S. C., who has mounted two lamps inside the hood of his car. Raising the hood causes the lights to be turned on automatically. A separate toggle switch snaps them off for daytime work on the engine of the car.

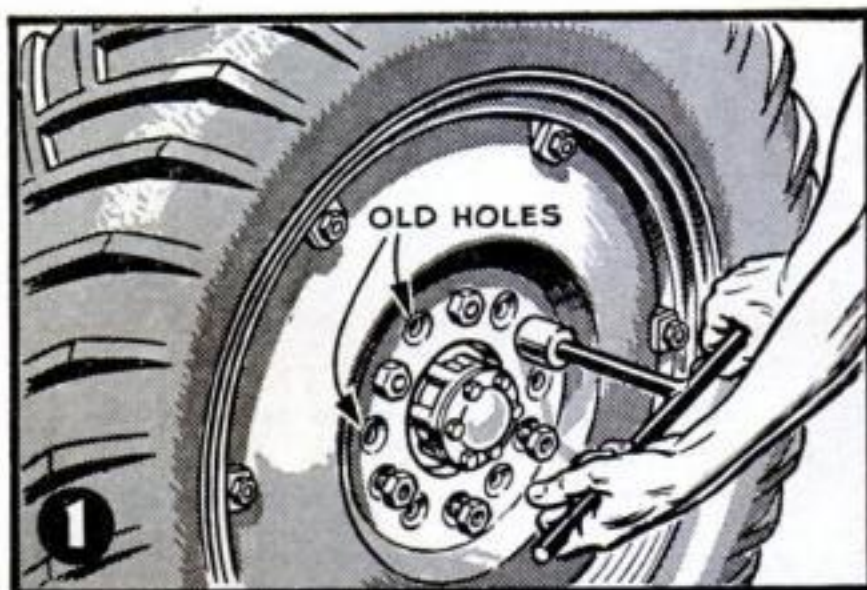


and Rubber Co., and is expected to increase the output of much-needed rubber. Items to be processed are subjected to electronic heat treatments at frequencies of 10 to 100 megacycles. The photo shows a small tire being removed from the electronic "cage."

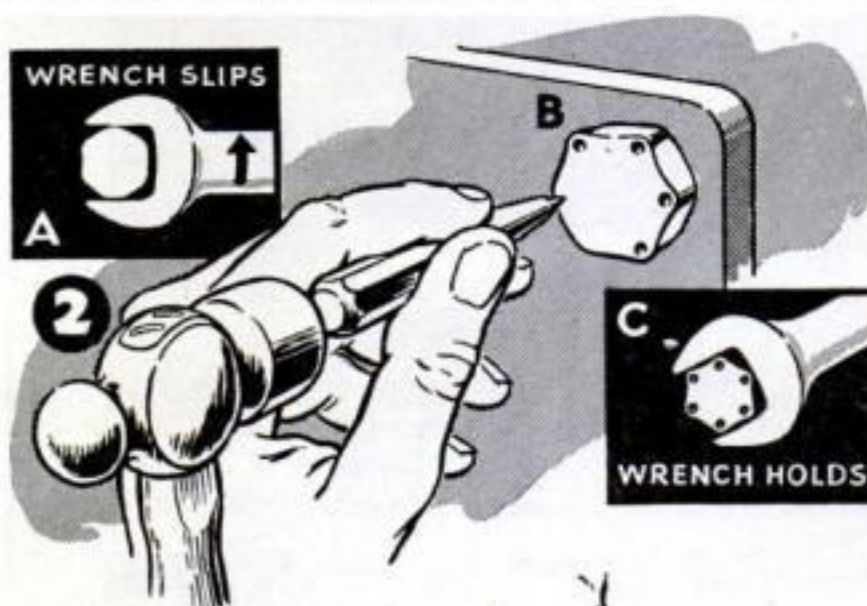
SHARE YOUR CAR-SAVERS as you share your car. And if your pet auto tip is of interest and value to other car owners, it is worth money to you. Describe the idea in 100 words or less, and send it, together with pencil sketches, to the Automobile Editor, POPULAR SCIENCE, 353 Fourth Avenue, New York 10, N. Y.

USEFUL AUTO HINTS

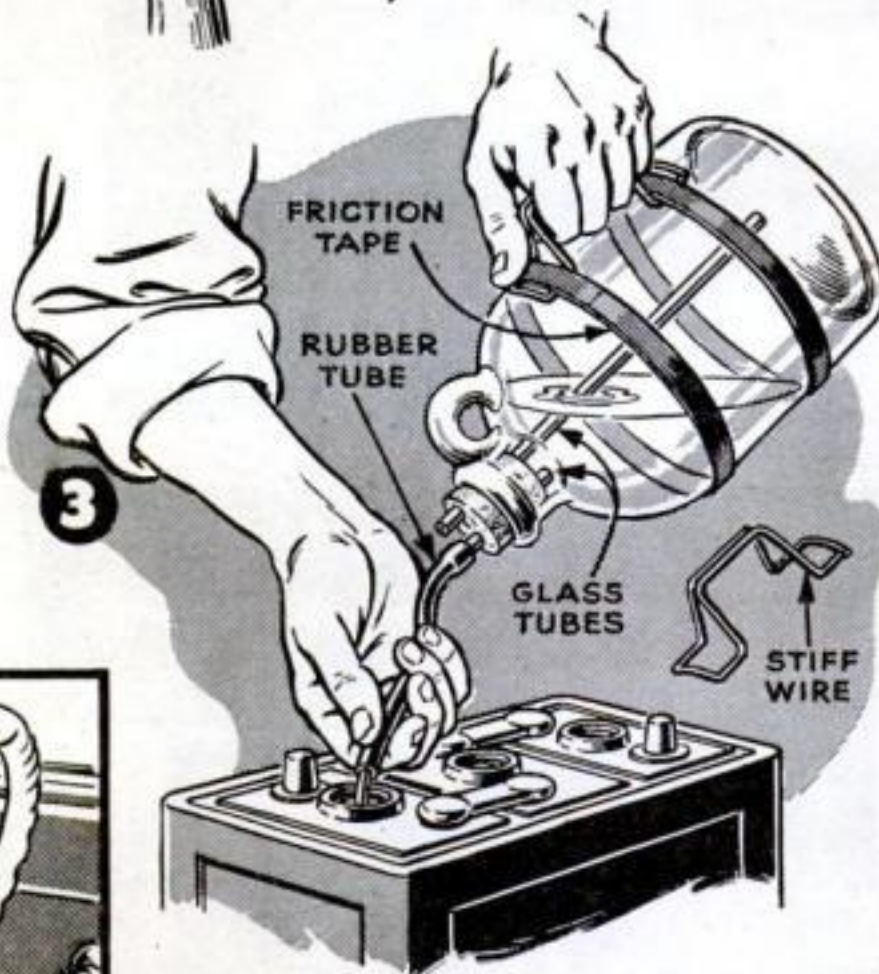
1 DAMAGED WHEELS often result when trucks or trailer tractors have been run with loose wheel-mounting lugs. To repair this defect without providing new wheels, remove any similar wheel in good condition, fit it over the damaged one as a guide, and drill new holes in the spaces between the enlarged openings.—H. W. S.



2 ROUNDED CORNERS on bolts that have been turned up tightly create a problem when the time comes for them to be removed. If your wrench slips, expand the corners of the bolthead slightly by indenting with a metal punch. The wrench will then be able to get a secure grip on the resisting head.—J. K.

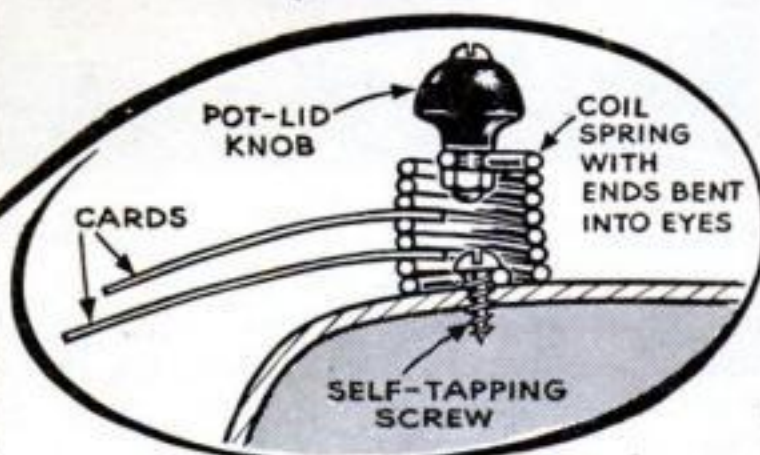


3 BATTERY WATER can be poured accurately, even into out-of-the-way well openings, with this handy filler made of a half-gallon jug. Drill two holes in the cork and insert one long glass air vent and one short pouring tube. An 18" section of rubber hose should be taped securely to the pouring tube. Bend a handle of coat-hanger wire and tape it to the center of the jug so that it can be held with one hand while the other controls the flow of water.—R. S.



4 DASHBOARD CLIPS for keeping toll books, route maps, addresses, or other needed papers at your finger tips can be made with just a few turns of a coil spring. Hook the bottom loop around a self-tapping screw and attach it to the dash or between the sections of the windshield. A pot-lid knob bolted to the top of the spring will help to separate the turns.—W. E. B.

Drawings by STEWART ROUSE





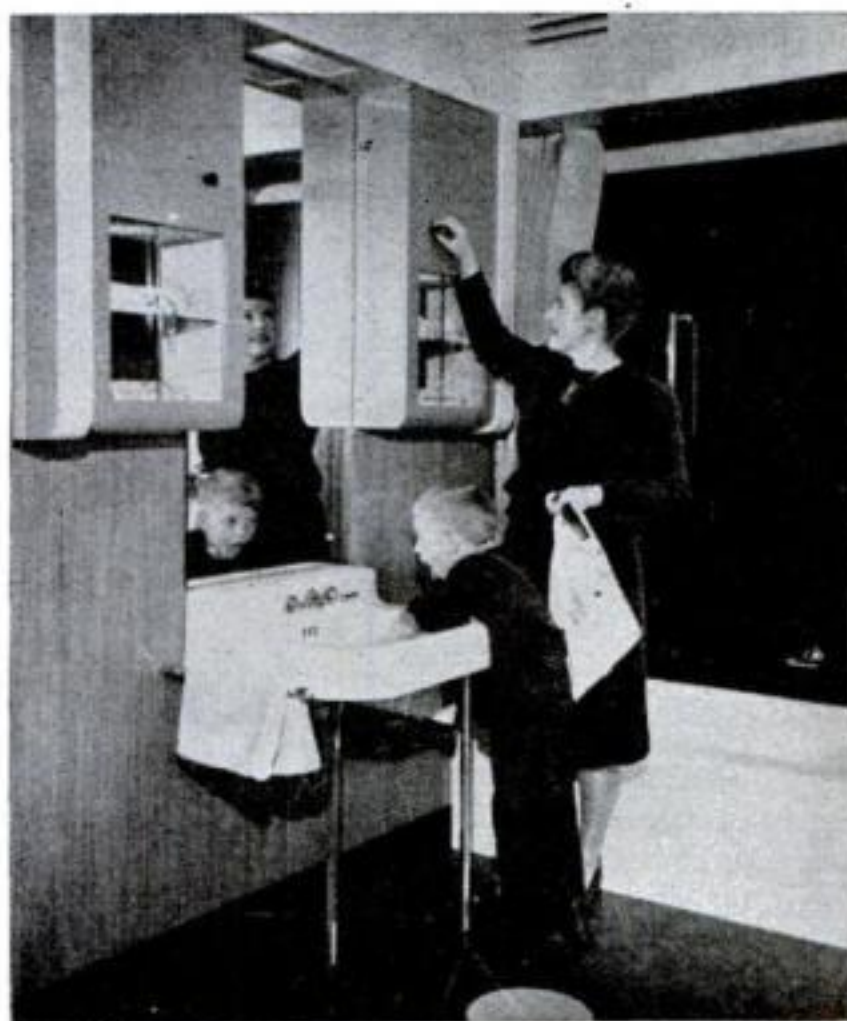
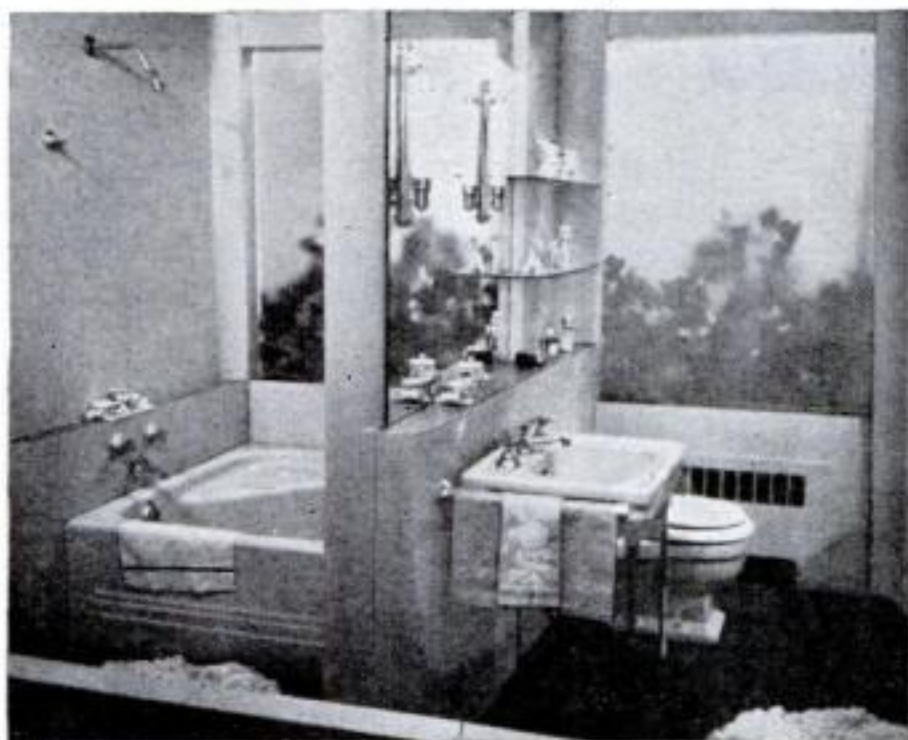
POSTWAR KITCHENS designed for the hundreds of homes the British must build in London and other bombed-out areas combine utility, beauty, and compactness. Plastic materials will be widely used. The "package kitchen," at left above, includes a

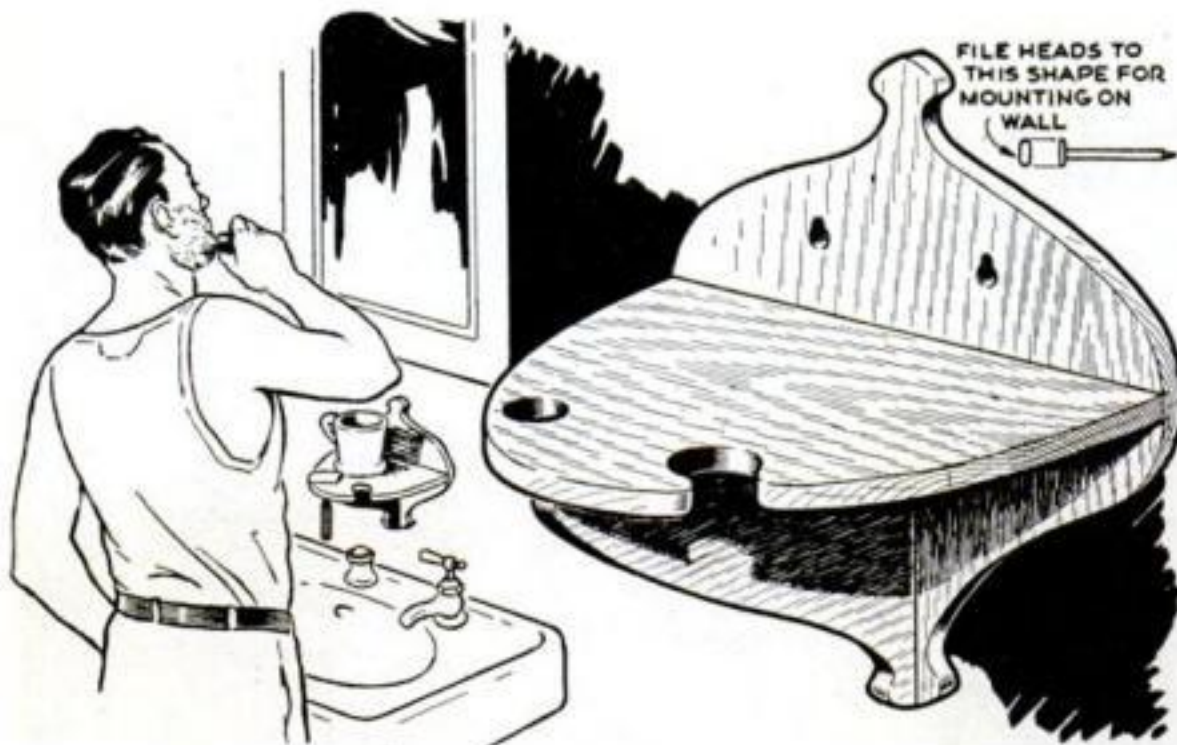


gas cooker, water heater, refrigerator, and storage space, all installed at a cost of approximately \$220. The latest gas water heater, right, has a regulator between the taps to control the water temperature. Boiling water for tea can be drawn from it.

DOUBLE-DUTY BATHROOMS are one solution to the early-morning rush problem, for two persons can use the room simultaneously. One compartment contains the bathtub and shower, the other the lavatory and water closet, and a door through the dividing wall provides privacy for the occupant of each. Improved equipment planned for the bathroom of tomorrow includes a cabinet in which stored linens are visible

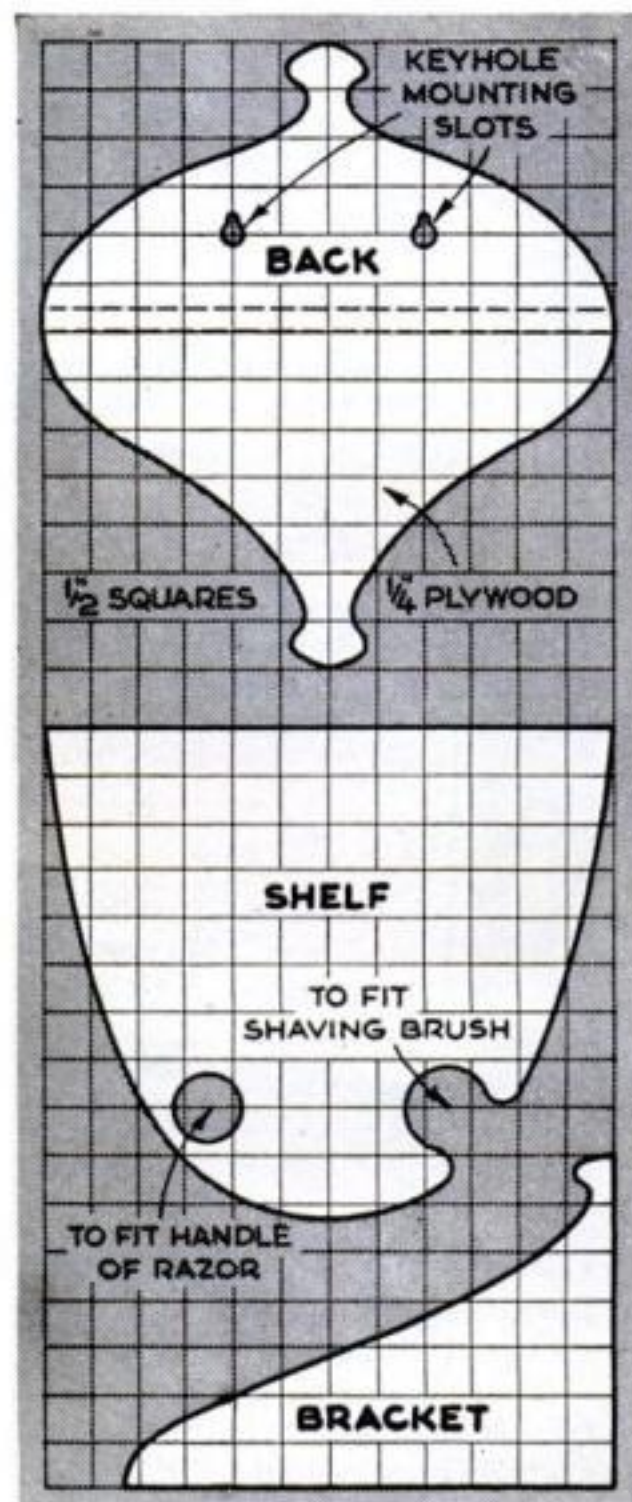
through sliding glass doors, a mirror extending to the top edge of the lavatory, and an improved mixer for controlling the temperature of the shower water.





Shelf Keeps All Shaving Needs Handy

THIS shaving shelf fills two needs: it keeps your razor, brush, and soap handy so you will not have to fumble through a crowded medicine cabinet, and it is a convenient place to put down the equipment during the actual process of shaving. The shelf consists of three pieces, all cut from $\frac{1}{4}$ " plywood. After jigsawing the parts, sand them thoroughly and assemble with brads and glue. Finish to suit the bathroom. If you use shaving lotion and shaving cream, change the dimensions to suit your special needs. Two screws or nails spaced to coincide with keyhole mounting slots hold the shelf to the wall. If you prefer not to keep such shaving articles in the open, you still should find the shelf a convenience during the period of actual shaving.—BILL FREDERICKS.



Autographs Burned into Wood Decorate This Cigarette Box



AUTOGRAPHS burned into the top and sides of a wooden cigarette box form an original and flattering variation on the familiar guest-book idea. Have your friends sign

their names either on ordinary white paper or directly on a box made of light-colored wood. If they sign on paper, copy each signature on tracing paper, find a spot for it on the box, and transfer to the wood with carbon paper. Burn in the name with a small-tipped burning tool or, if such a tool is not available, a short length of wire fitted into a wooden handle. When you have filled all the space, smooth the wood lightly with sandpaper, and finish as desired. Autographs also make excellent decorations for handkerchief boxes.—HERMAN R. WALLIN.

Carton Turned into Useful String Holder

PROVIDED with a face and ears, a pint ice cream carton is transformed into a sprightly holder for a ball of string. First, sketch the eyes, nose, and mouth with India ink. Form the ears by slipping two poultry markers into holes on opposite sides of the container. Place the string inside and feed it through a hole in the lid.—BENJAMIN NIELSEN.



Spare the Brush— But Save the Bowl!

TIME was when a man's shaving mug was one of his oldest and proudest possessions, brave in gilt edging and ornate lettering. Not so with its successors. Today even these shapely wooden shaving-soap bowls seldom stay around long enough to feel at home.

There's a perfect lather of ideas on this page illustrating the variety of uses to which your empty suds steins can be put.



CANDLEHOLDER

For moments of relaxation, the subdued light of a candle adds an inimitable touch. Tin-can metal can be used for the arms and holder. Rubbed with steel wool and lacquered, tin plate takes on the luster of silver.



PINCUSHION

Smiling at his perforated chassis, the happy mandarin asks for more pins. His head is made of dowel or cork; the rest of him out of any suitable cloth-covered wadding, glued into the bowl.



INCENSE BURNER

Holes bored through both bowl and cover provide an adequate draft for incense smoldering on a scrap of metal placed in the bowl.

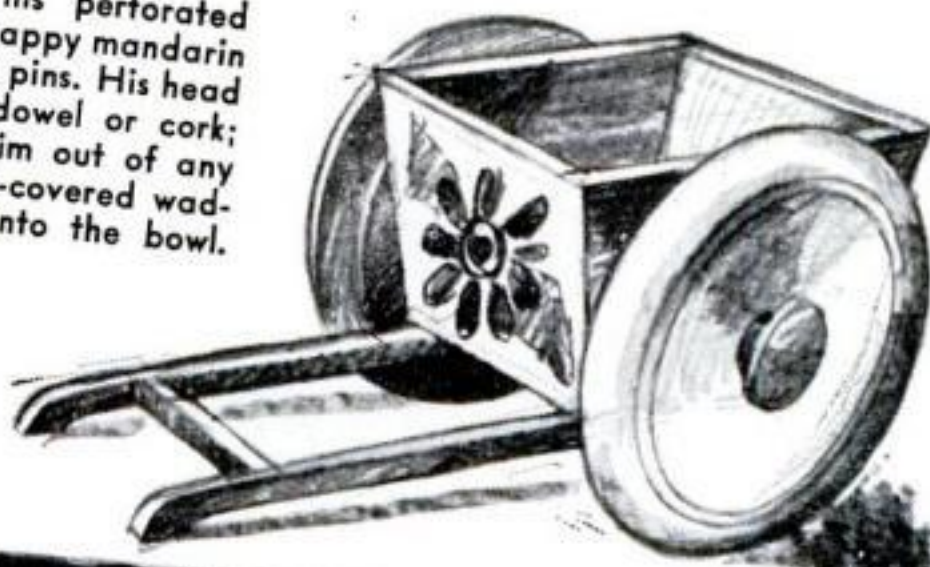
ASH TRAY

Scrap-metal cigarette receivers, plus a glass or metal liner, permit use of the bowl as an ash tray.



FLOWER CART

Bowl covers serve as the wheels of a cart built to hold a small flowerpot. Make the body out of thin wood stock. The ends of the shaft should tip downward so that the cart is level when it is at rest.





Form is of primary importance in archery. So is shaping a bow. L. E. Stemmler uses a plane on a bowstave, above, and . . .

Archery

ONE of the oldest sports in the world, archery is still going strong both for hunting and target shooting. Many hunters prefer the bow and arrow, and some states, especially during the war shortage of ammunition for sports, set aside hunting areas for archers only. Because it is a graceful and satisfying sport, many women have en-

tered target-shooting archery competitions.

The manufacture of the archer's tackle requires a craftsman's skill. One of these craftsmen is L. E. Stemmler, of Queens Village, N. Y., who is shown in the accompanying photos. Like his father before him, he supplies archers all over the country with finely made bows and other equipment.

Feathers put on an arrow to balance it in flight are carefully stripped and sized. Here, the vane is being separated from the quill. In some cases a thin portion of the quill is left on the vane.

Bits of the plumage of last Thanksgiving's turkey may guide the flight of arrows used to hunt wild turkeys for the next Thanksgiving. The process of gluing feathers on the shaft is called fletching.



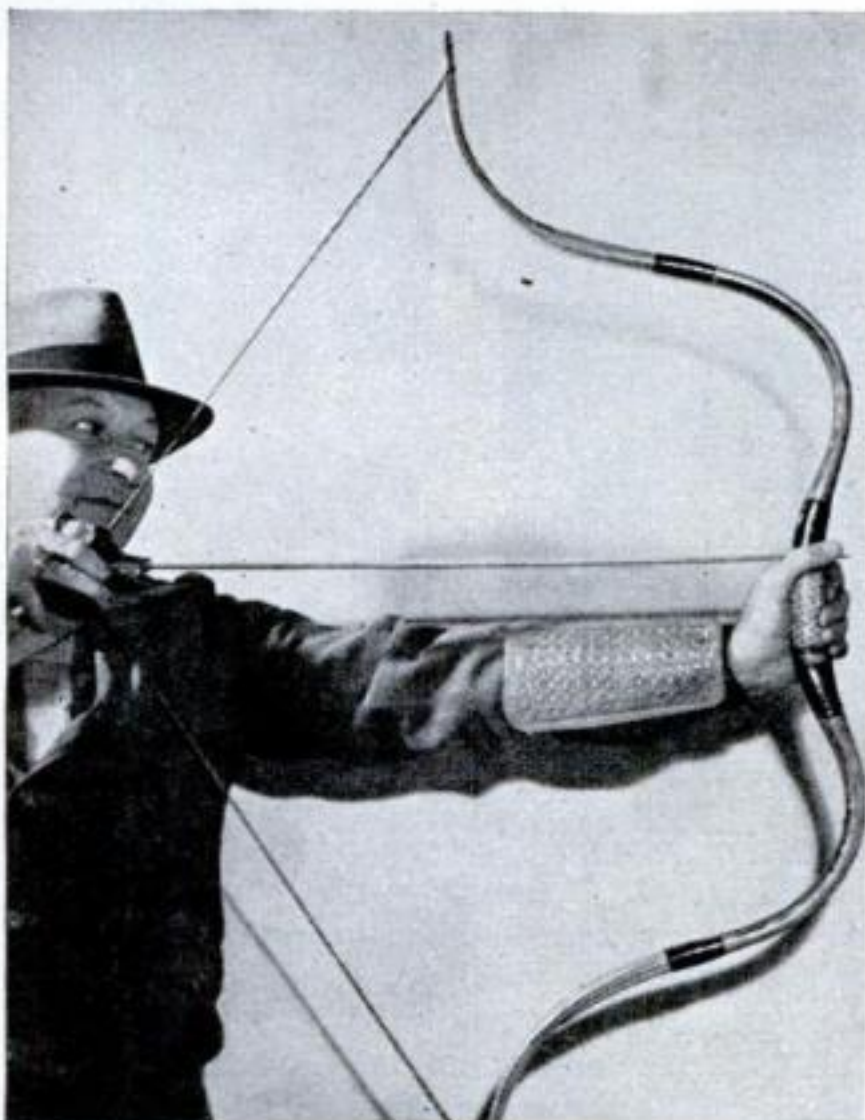


... here he nocks the ends for the bowstring. One loop is permanent in a notch; the other can be slipped off.

Craft



Roughing out an Osage bowstave with a spokeshave. The grain of the wood must be carefully followed when making both the yew and Osage bows, and the only way to do this is by hand. Other popular bows are made of lemonwood and orangewood.

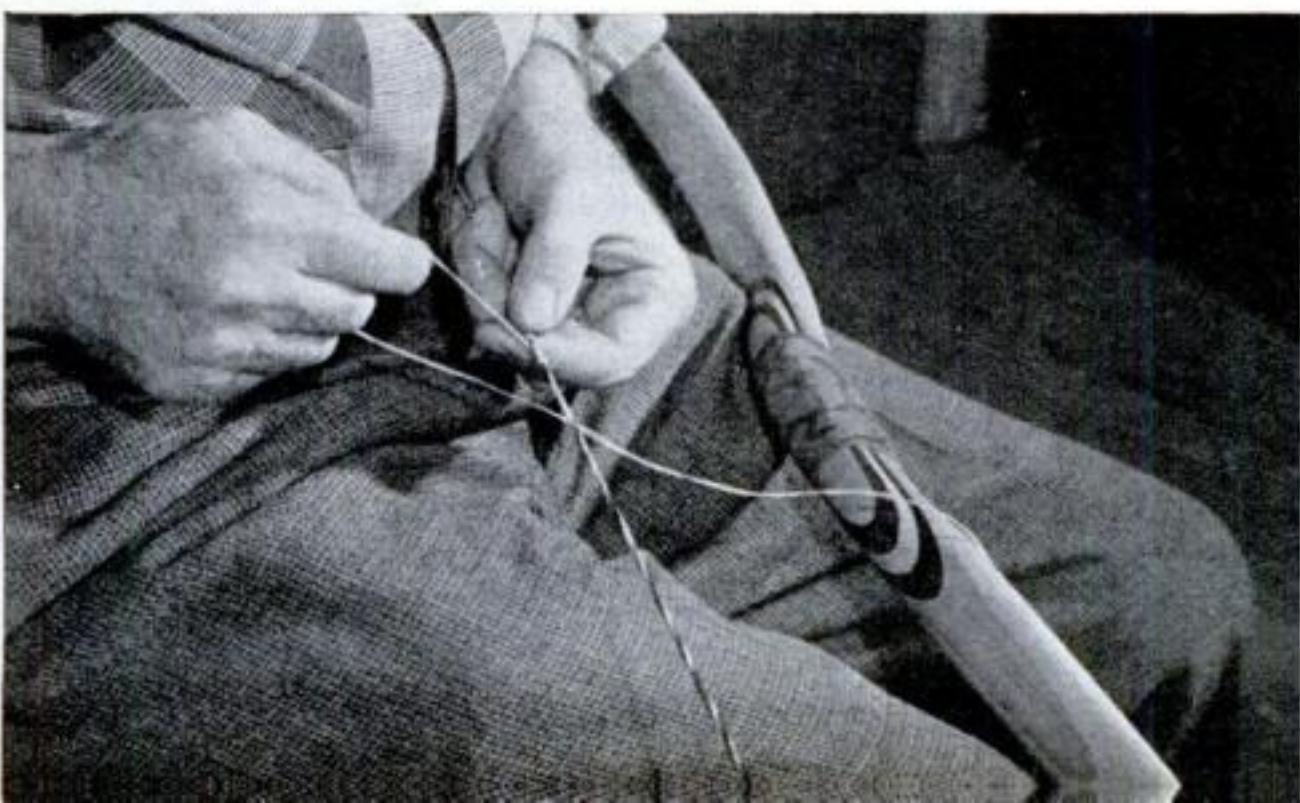


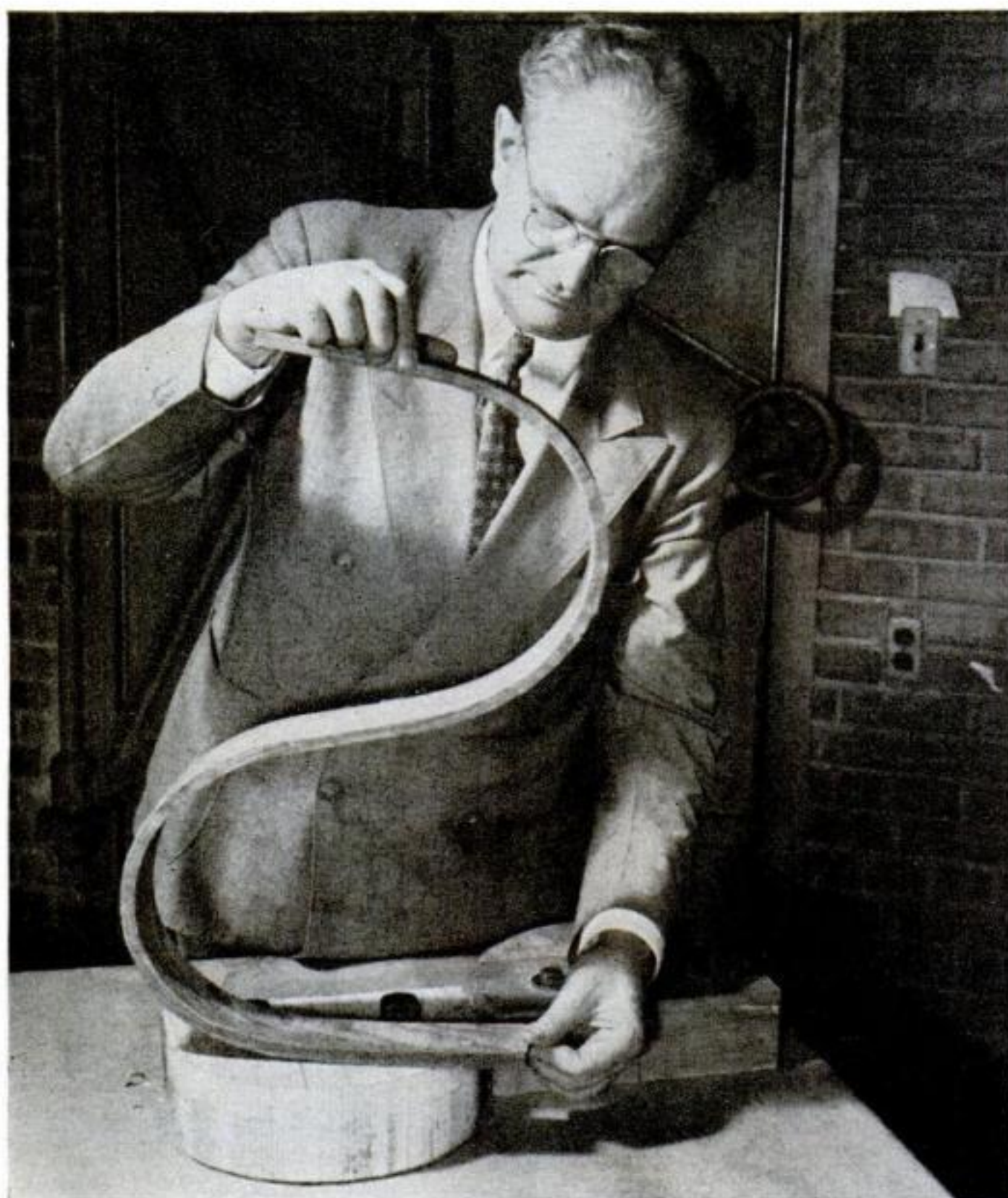
A bowyer's joint, right, is used in joining two short pieces of wood to make a bow of the required length. This is called a double fishtail.

Left, a composite bow formed of sinew and Asiatic buffalo horn. It is of the Oriental type and is now rarely used. Oddly shaped bows have been made for centuries.

Strings require expert attention to withstand heavy drawing weights. Right below, an end of a tapered bowstring is thickened by twisting. Strings are made from flax and linen twine.

Below, the middle of a bowstring is whipped, or served, to make it stronger at the point where arrows touch it.





Out of the test tube are coming brand-new wood products such as uralloy, left, which can be tied into knots.

WOOD is one of mankind's oldest structural materials. We all know that it has its faults—that, for instance, it is weak across the grain and subject to attack by fire, by termites, and by rot fungus—but it is comparatively cheap, readily available, and easy to use. Progress has been made in working and fabricating wood—the tools we use aren't the same as the ones Noah used when building the Ark, nor do we any longer fasten the various parts of a boat together with treenails, as he did—but the basic material, with all its faults, has until recently remained the same.

Now, however, through the magic of chemistry wood is being made over into materials entirely different in character. In fact, so varied are these new materials that German technicians felt wood deserved a new name. Their syllable smiths thereupon turned out a new word—*universalrohstoff*—universal raw stuff, raw material from which many things can be made. Among the many newly developed types of wood products,

two are of especial interest to the craftsman—the glued woods and the improved woods.

The first and most familiar of the glued woods is *plywood*. It consists of a combination of three or more glued-up sheets of veneer. The grain of each ply runs at right angles to the grain of the sheet next to it. This makes a plywood panel as strong along its width as it is along the length. Because it can be made with any number of plies, because the plies can be of any desired thickness, and because they can be of any species or combination of species, it is possible to obtain a plywood to suit almost any special purpose. Until the development of plywood no board could be longer or wider than the tree from which it was cut. Now there is practically no limit to the possible size.

Plywood has been used for many years, but has become important as a material for outdoor use only since weather-resistant glues were developed. Ordinary plywood de-

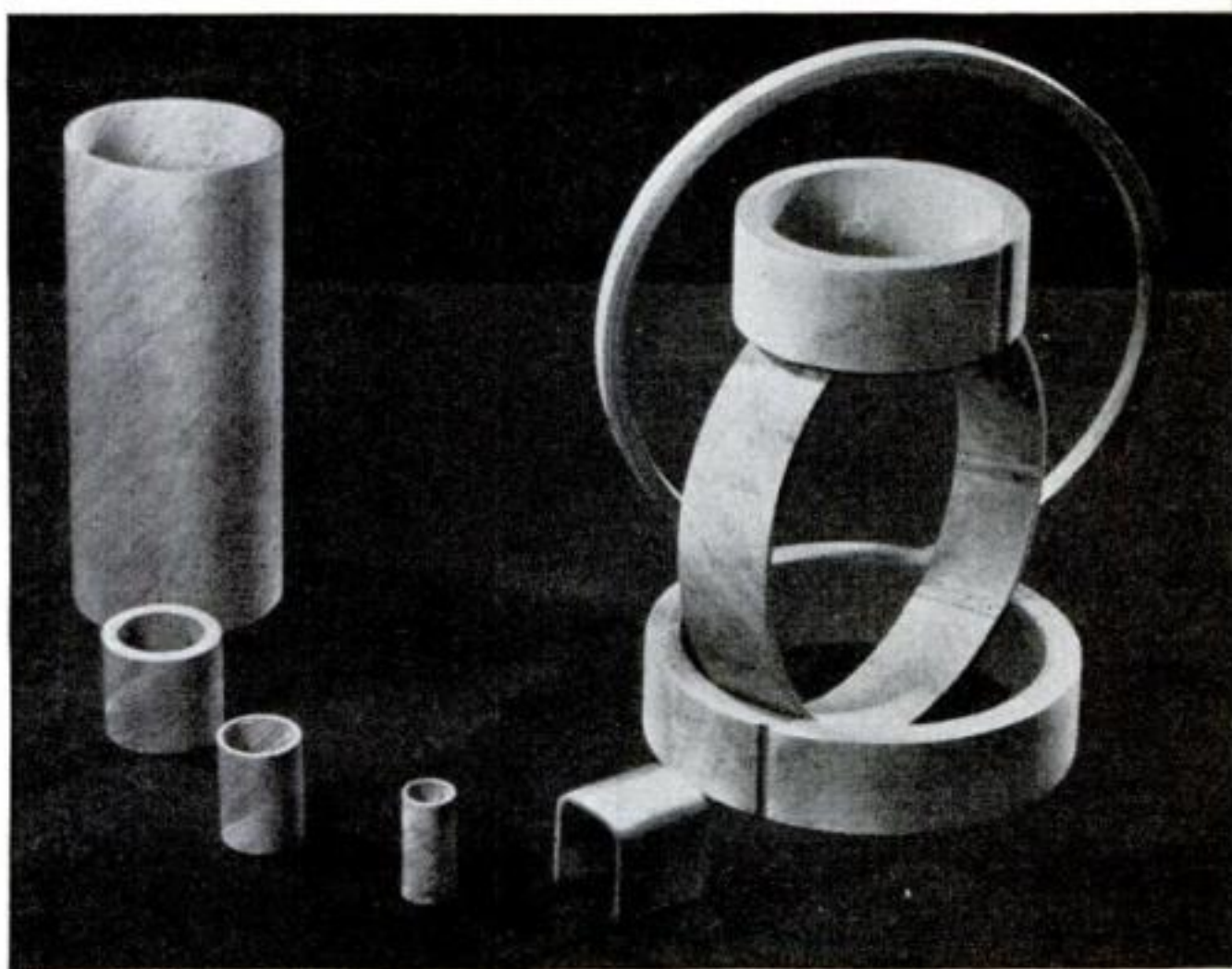


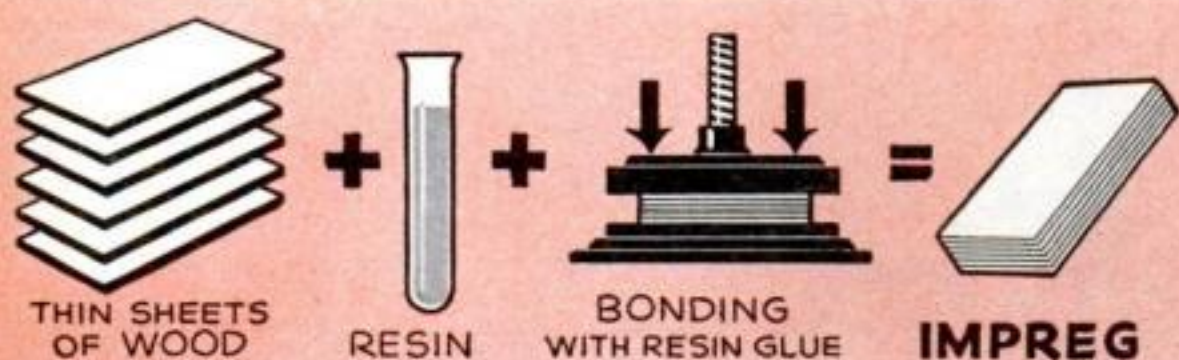
New Woods for the Craftsman

depends on the cross-banding of the plies to restrain across-the-grain dimensional changes mechanically. Since it is impossible to prevent such swelling and shrinking by mechanical means, this restraint merely alters the direction of the dimensional change. Instead of swelling across the grain, the wood swells in thickness, causing unevenly developed stresses. These cause the plies to work and result in serious face checking.

To reduce these stresses to such an extent that checking

Tubular plywood is light enough to float, yet can bear a heavier load than can steel tubing. This characteristic makes it a sound building material. It has great possibilities for the craftsman.





Impreg, a plywood-like material of limited usefulness, was developed by the Forest Products Laboratory. It has been largely superseded by compreg, which is described below.

withstand impact stresses. This casehardened resin-impregnated wood would seem to have a real future in the construction of trestles, towers, buildings,

boats, and planes.

is practically eliminated, resin glues are now being used. Of these probably the most effective stabilizers are the phenolic resins. The ureal resins, especially methylolurea, are also good, but reduce swelling and shrinking but half as much as do the phenolics.

Both the plywoods and the other types of resin-impregnated woods that are described below have a number of desirable qualities that natural woods do not. They are resistant to moisture, rot, termites, electricity, fire, and acid. Weather and temperature changes have little effect on them. Their compressive strength and hardness are increased by as much as 50 percent. In one very important respect, however, they are inferior to the natural woods—their impact strength is materially reduced; that is, both phenolic resin and ureal resin embrittle wood to a large degree.

If experiments now under way are successful, this fault will be minimized. Just as soft steel, which is not brittle, may be casehardened to give it a strong, hard exterior while the core remains resilient and impact-resistant, so wood may be treated by partially impregnating it with resins and differentially compressing it to produce a hardened surface while the untreated inner fibers remain in a natural, resilient state to

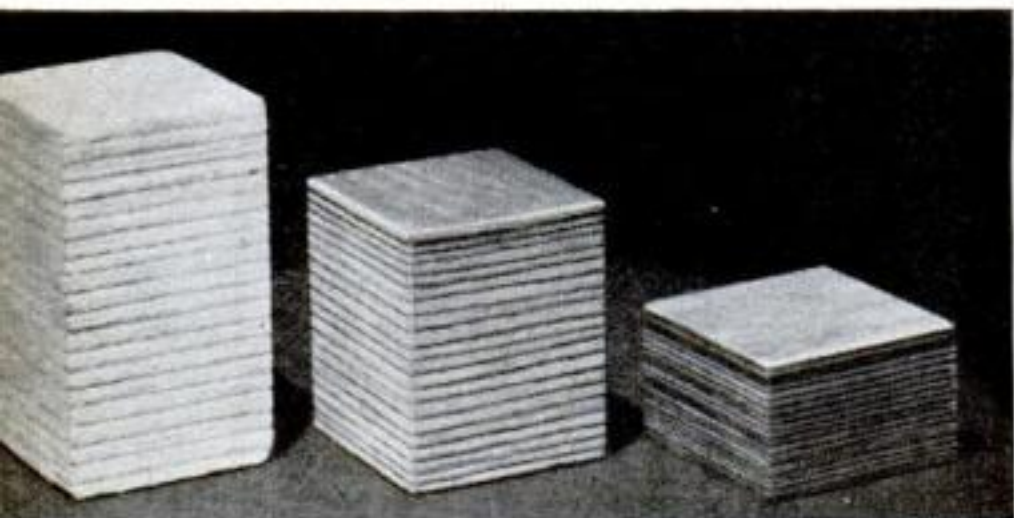
boats, and planes.

In a new type of plywood, thin veneers are wound on mandrels to form hollow tubes. These are bonded with phenolic or ureal resins under pressure and heat. The product is called *tubular plywood*. It varies in diameter from about $\frac{1}{2}$ " to 12" or more. Since it has a specific gravity of considerably less than 1.0, it will float. Weight for weight it will carry a heavier load than steel tubing. In working it, ordinary woodworking tools can be used. It won't splinter and can be threaded.

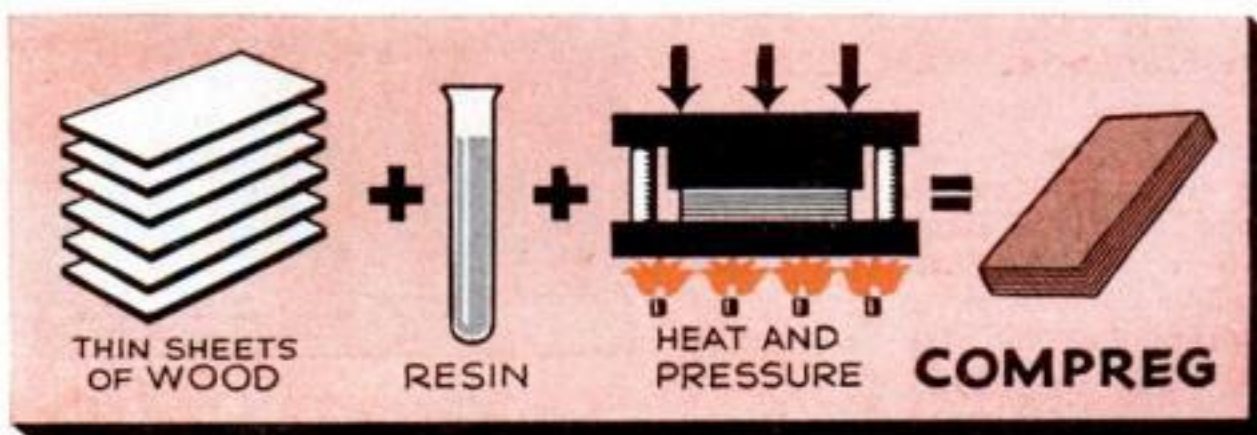
At present it is being used for aircraft stiffeners, electrical conduits, antenna masts, shipping containers, life rafts, and telescoping tent poles and boat masts. In the home it might be used for lighting fixtures, furniture and picture frames, and air-conditioning ducts. Other miscellaneous potential uses include ski-pole, tennis-racket, and golf-club handles, ship railings, oars, ladders, tripods, flashlight cases, thermos-bottle covers, musical instruments, and lipstick cases. And these are only adaptations of products now in use.

Similar to plywood, except that the grains of the laminations all run in the same direction, is an improved wood product known as *impreg*. It is made by soaking wood veneers in raw phenolic resin, stacking them, and applying pressure until the resin has set. Impreg has a grain like wood, but it is a harder, firmer, and heavier material. Developed by the Forest Products Laboratory of the U. S. Department of Agriculture, its most important use seems to be for gears and bearings in machinery.

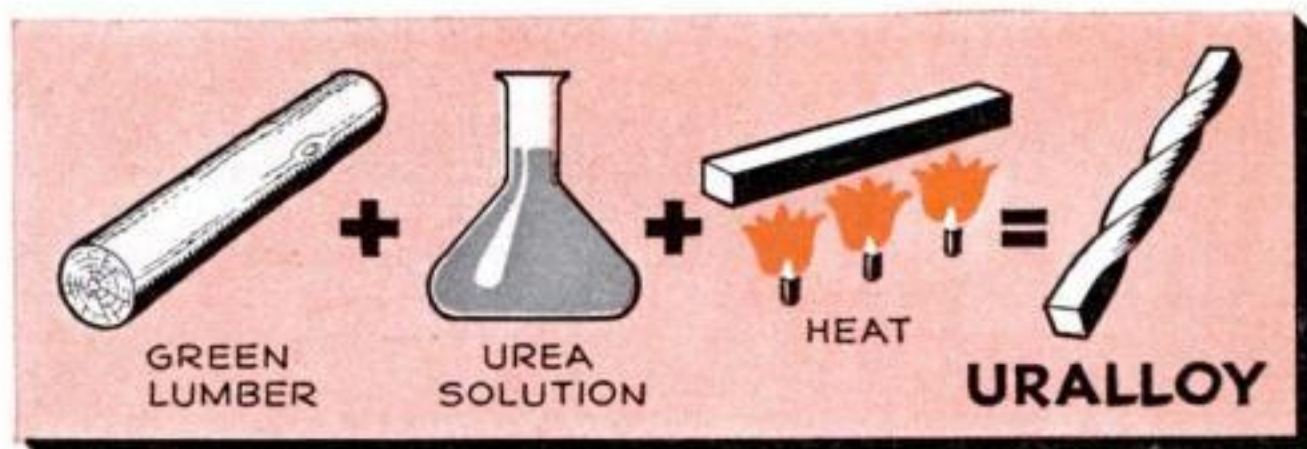
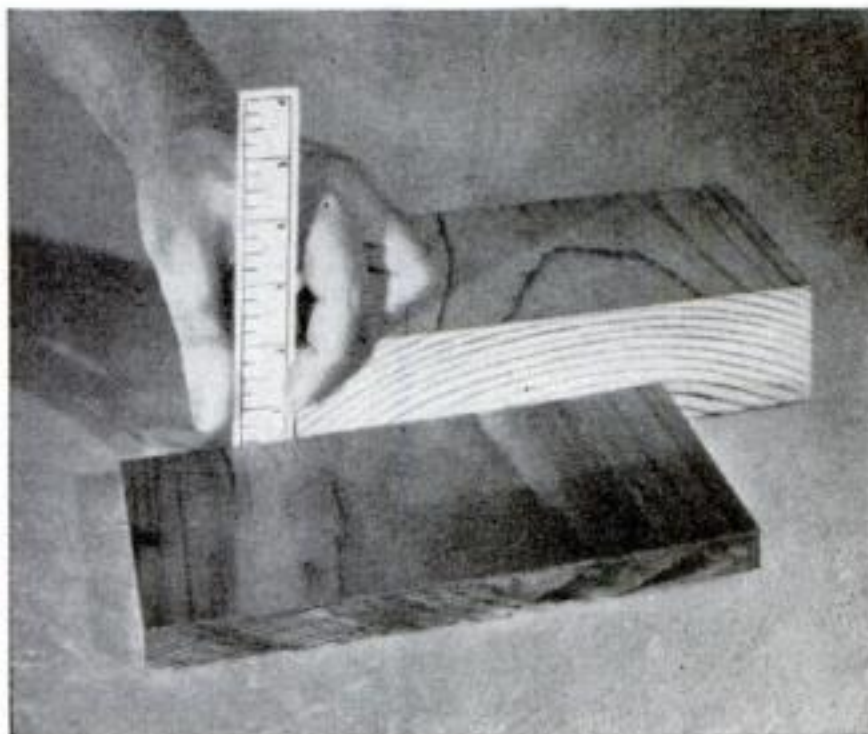
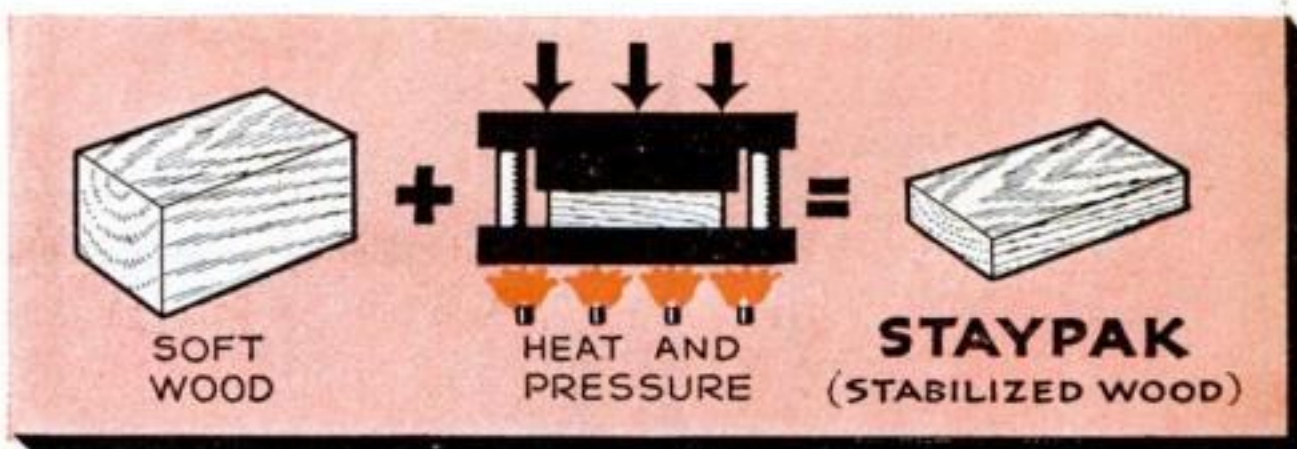
Another improved laminated product, called *compreg*, is made the same way as impreg except that heat as well as pressure is applied when the resin is setting. The resultant material is one third to one half as thick as the original veneers. It has all



In making compreg, both heat and compression are applied. That pressure is effective is graphically shown above. The samples were all originally the same, but each has been compressed differently.



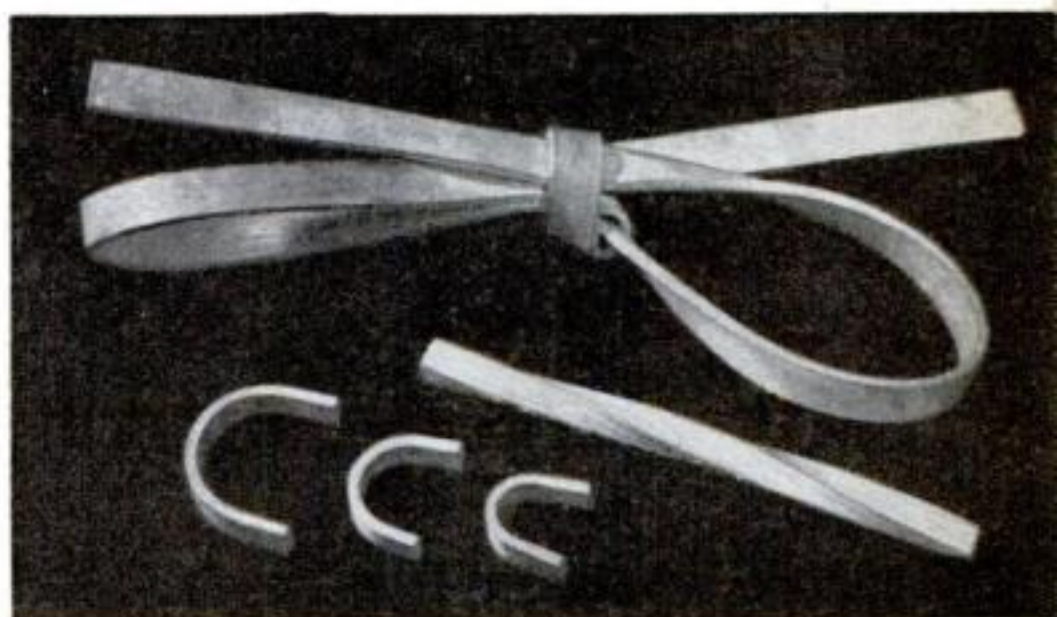
In the picture at the left below, a technician removes a specimen of staypak from a hot-platen press while holding in his other hand a piece of the white fir from which the staypak was made. A close-up of the two samples appears at the right. The staypak is much thinner than the original wood and has a rich, dark finish throughout. It is about twice as tough as compreg.



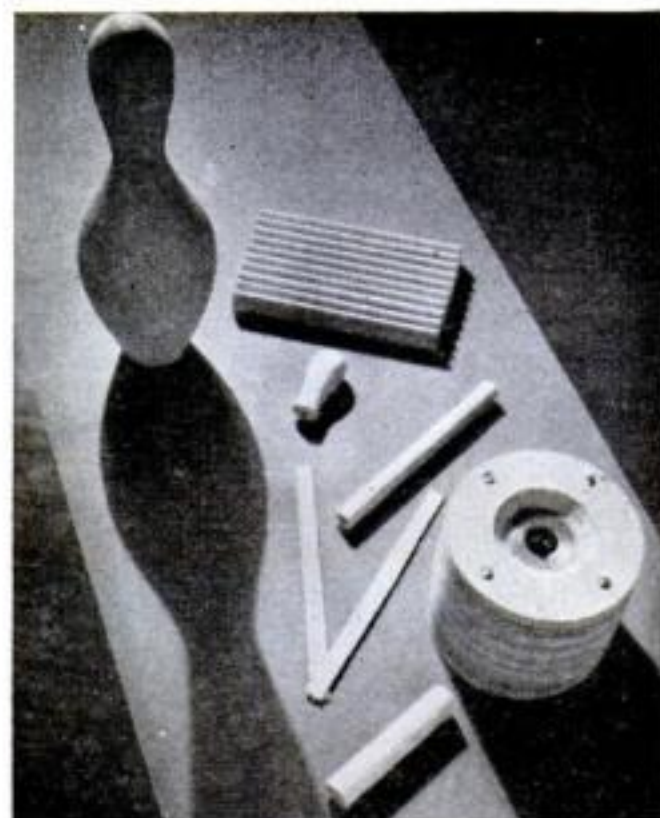
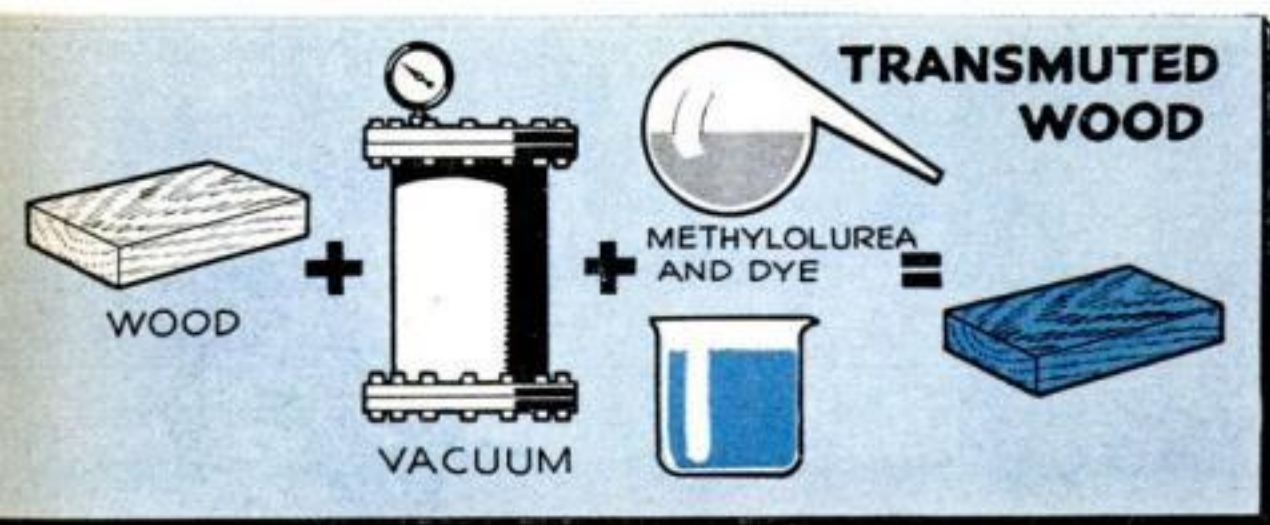
Green lumber for uralloy can be treated with urea or with urea aldehyde. Urea produces a thermoplastic uralloy, while that made with urea aldehyde is thermosetting. The latter retains its shape permanently once formed, while the thermoplastic type can be reshaped into new forms at any time by the application of more heat.

of the advantages of impreg plus increased density and hardness, high luster, and a rich, dark finish throughout. The increase in density increases the tensile strength, but at the same time increases the brittleness of the substance; thus compreg has less elasticity and impact strength than impreg. Since it has such great density, metalworking rather than woodworking tools should be used when machining it. The Forest Products Laboratory, which developed compreg, announces that it is now being used in such diverse products as nuts and bolts, plane propellers, and aircraft-carrier decks.

Staypak is probably the most universally applicable of the new improved woods. It is formed by subjecting a block of soft wood to extreme compression under certain optimum conditions of temperature and moisture. The chief advantage that staypak has over the other products described here is that, because no resin solution is used during the forming process, it is not brittle. The



compressed woods developed prior to staypak were all susceptible, under high moisture conditions, to swelling and to "spring-back"—a release of the pent-up stresses that result from compression. While staypak will also swell, the swelling is so slow that for many purposes it need not be considered. [Turn the page.]



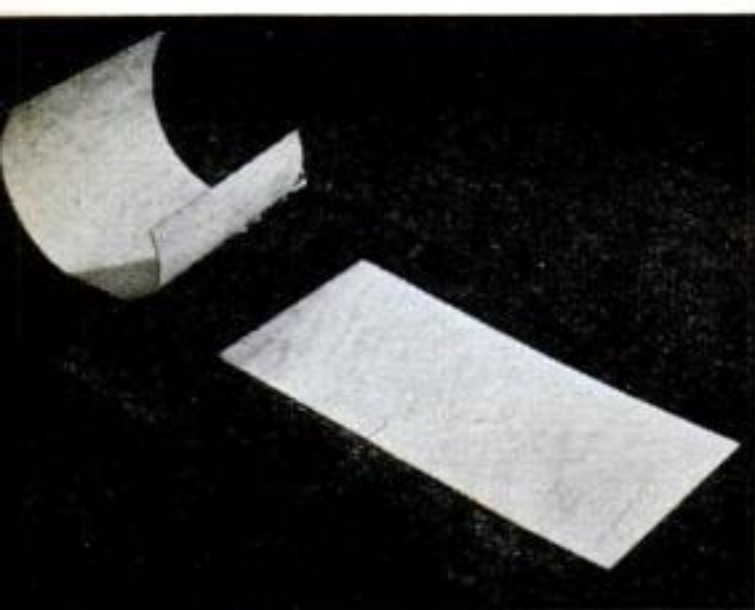
Physically, staypak, which was developed by the Forest Products Laboratory, is very hard, is about twice as tough as compreg, and has a rich finish throughout. It machines nicely with metalworking tools and takes a good polish on all cut surfaces. It can be glued to itself and to untreated wood. Its high impact strength makes it useful for strengthening the joints between fuselages and wings in small planes, and for propellers, tool handles, mallet heads, sheaves, gears, and so on. Because it swells, although slowly, it is not recommended for underwater use.

Recently a special treatment was devised that alters wood so, when heated, that it becomes sufficiently plastic to be bent easily into any desired shape, compressed, and even tied into knots. In this treatment, green wood is impregnated with a concentrated solution of urea aldehyde; then air or kiln-dried. When cool, the improved wood, known as *uralloy*, is almost as hard as iron and permanently holds the shape to which

Transmuted wood was used in making the items shown here. All are much stronger than they would have been if made from untreated wood.

it has been bent. Since it is brittle and but half as stable as phenolic-resin treated wood, uralloy's usefulness is largely limited to decorative objects. In this limited field, though, the material opens up new vistas to the ingenious designer and craftsman.

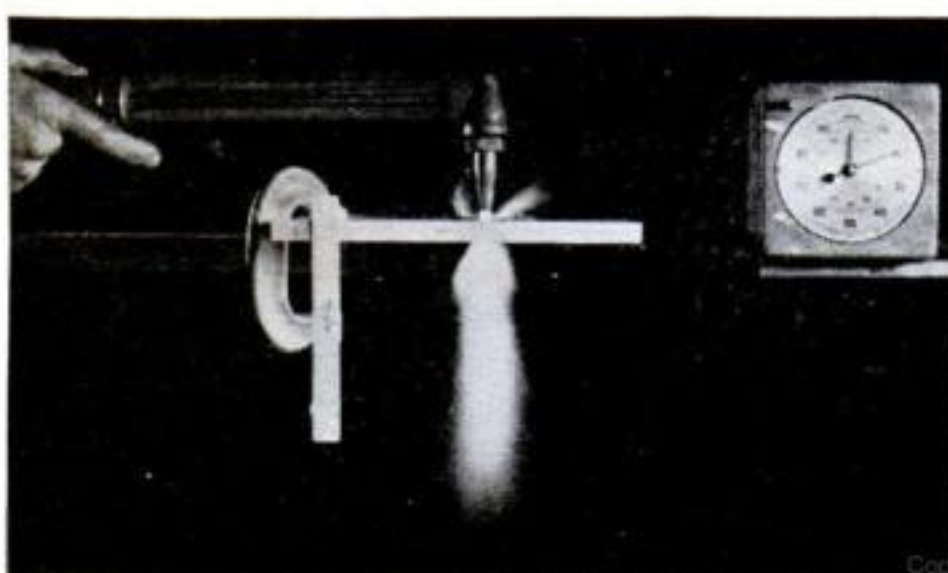
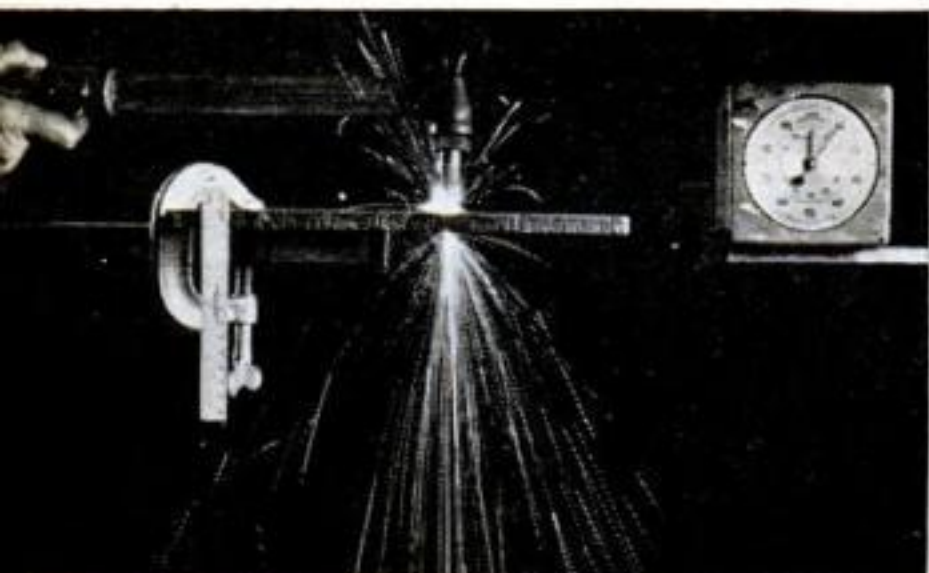
Still another improved wood product is *transmuted wood*, which was developed by the Forest Products Laboratory and, in parallel research, by E. I. DuPont de Nemours and Company. In producing it, untreated wood is placed in a chamber and the air is exhausted. After an interval of time, a water solution of methylolurea is put in the chamber and air pressure is applied. When the proper degree of absorption is attained, the wood is removed from the chamber for drying. Color can be imparted permanently to the wood by mixing a dye with the impregnating chemical.



That transmuted wood is more warp-resistant than natural wood is quickly demonstrated by laying an untreated and a treated veneer on a damp surface, as shown at left.

That it is heat resistant as well is indicated by the test shown below. The photo at the left shows the time needed for cutting through steel with an oxyacetylene torch. The other indicates that transmuted wood takes about twice the time to cut.

By this process some of the softer of the so-called hardwoods can be made harder than ebony. When it is realized that of more than 1,100 varieties of wood in the United States, only 50 or so are commercially usable, this transmutation process takes on special significance, for it holds out the hope that many of the valueless woods can be made over, and that softwoods may yet find their way into the finest products of the woodworker's art.



This Back-Fence Tomcat Can't Dodge

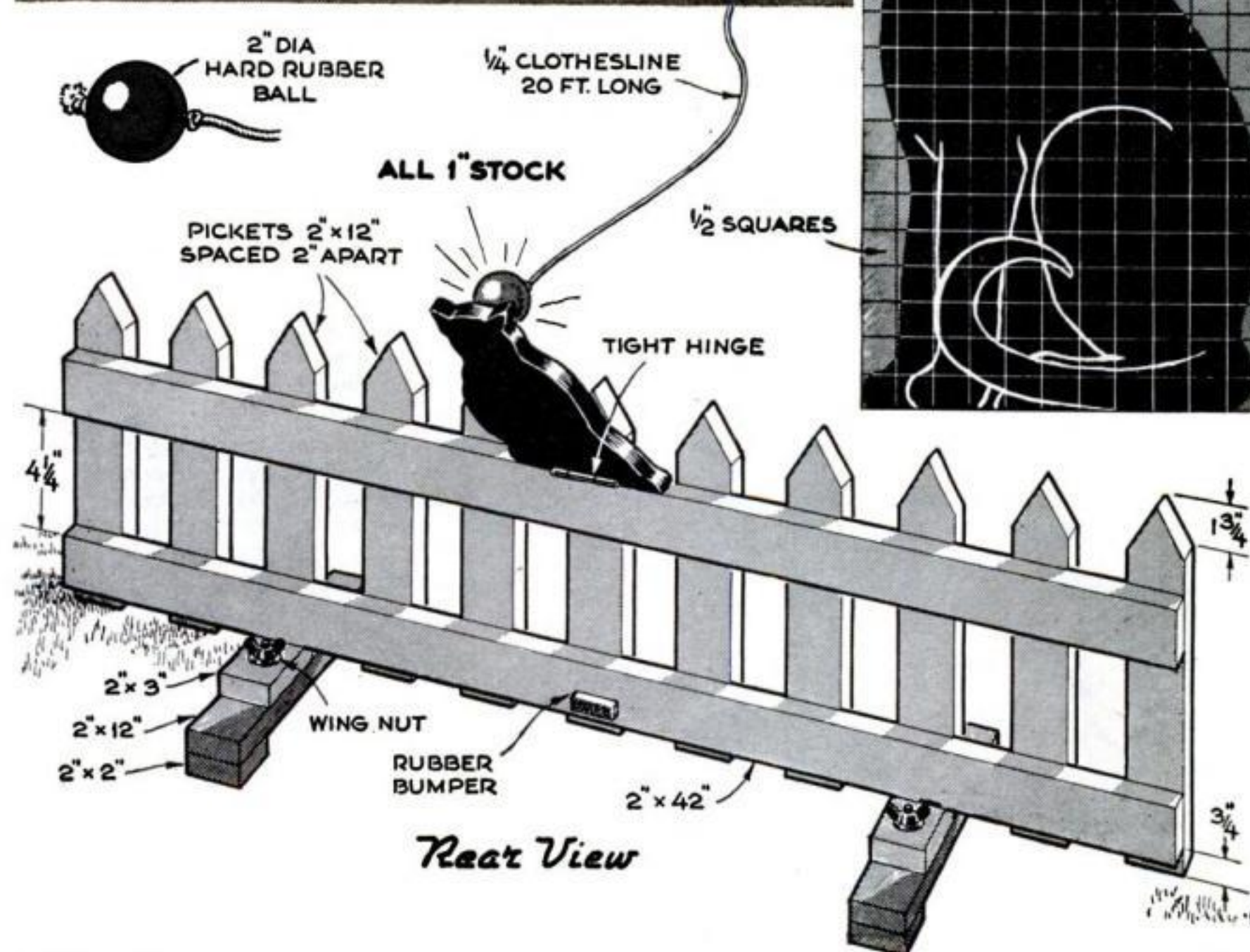
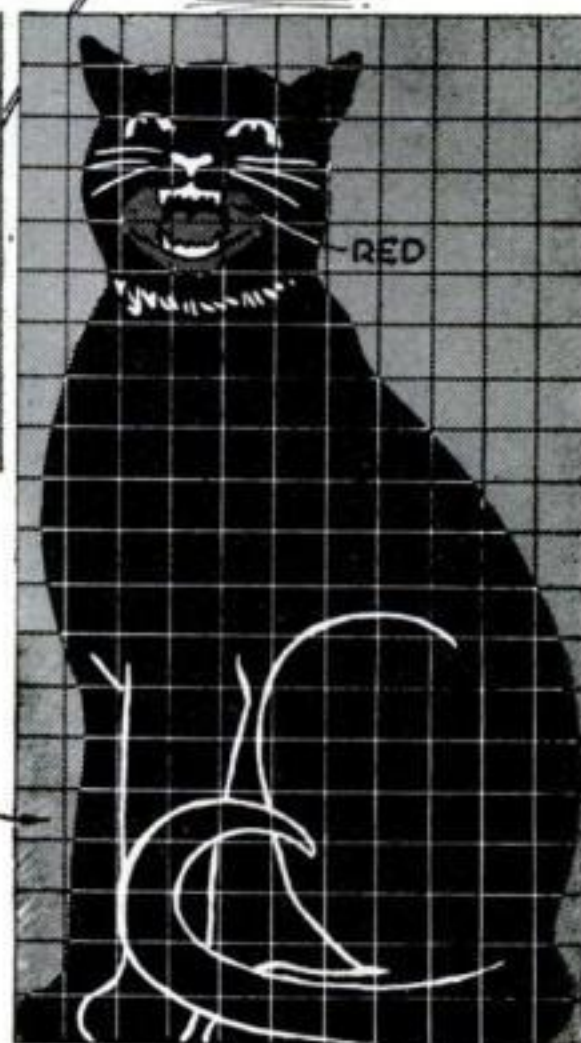
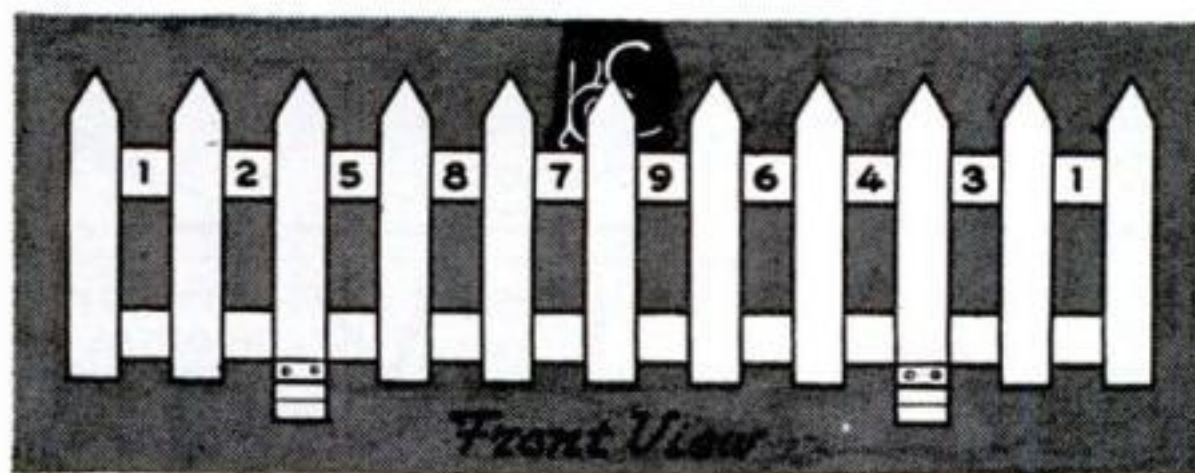
By MYRON FLEISHMAN

HAVE you ever pitched a shoe at a yowling cat with only the light of the moon to aim by? Unless you're big-league material, the chances are that you missed Old Tom by a mile. Here's a tricky game that shows how tough it is to knock puss off a fence and, incidentally, helps sharpen your aim for future contests with back-fence feline tenors.

If you have a picket fence, you need only cut out the cat and mount it on the upper rail, using a tight hinge so that it won't topple backward if the ball merely hits the fence. Mark the rail with scoring numbers.

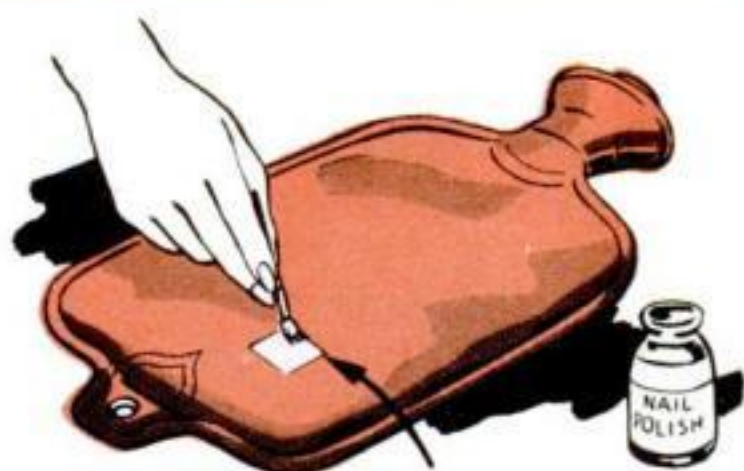
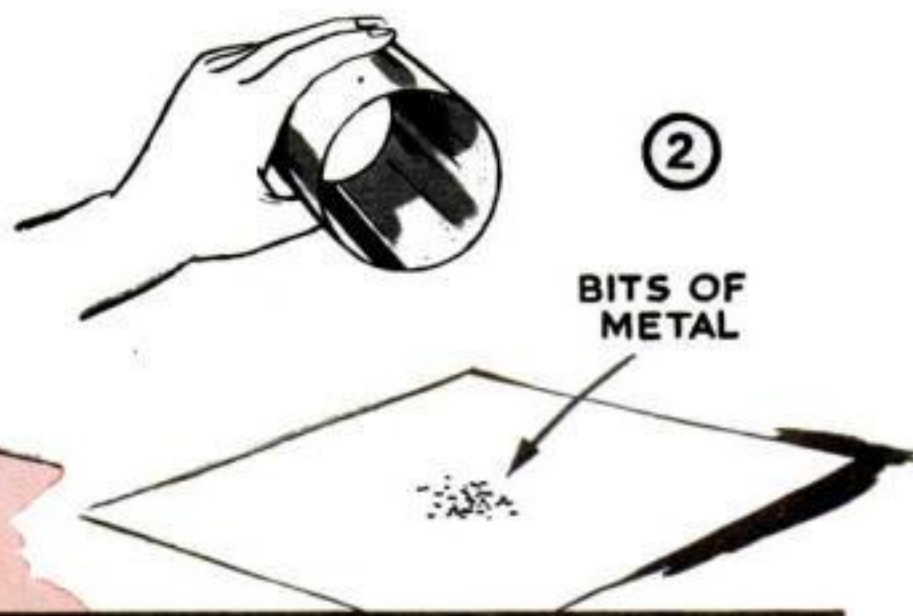
To build a portable fence that can be carried about the lawn, cut 11 pickets and nail them to two rails. Nail two blocks about 24" apart to the bottom rail and on these mount the feet.

In playing, hold a 20' coil of clothesline loosely in one hand and throw the ball with the other. Score 25 points if you hit the cat; if the line straddles the rail, credit yourself with the score made. A pull on the line retrieves the ball.

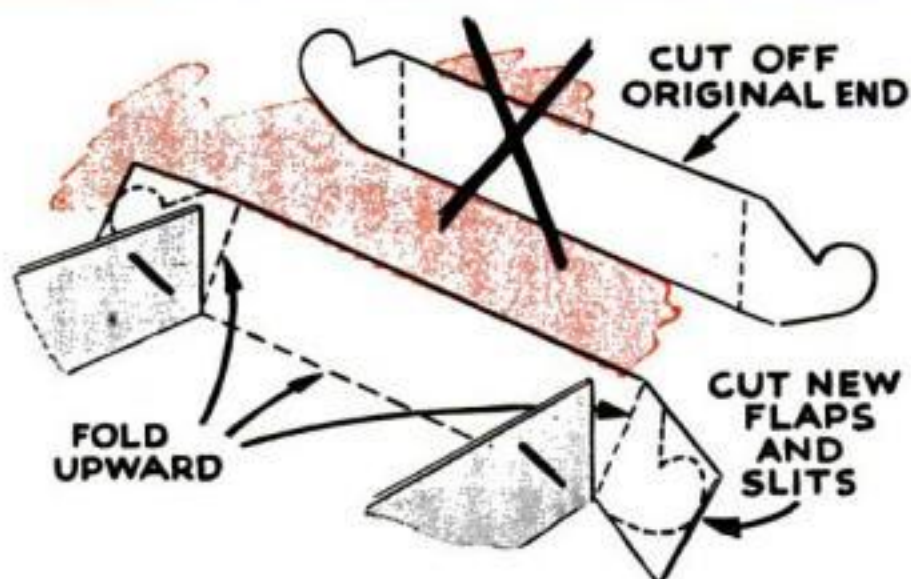


KEEPING

Some can openers cause bits of metal to drop into the can as it opens. To check on your opener, take a can already opened smoothly at one end, wash it well with hot water and soap to remove all grease, dry thoroughly, and place it, opening down, upon a sheet of glossy white paper. Then cut off the top with the suspected opener. Should any slivers be released they will be easily visible on the paper.



APPLY NAIL POLISH TO CLOTH PATCH



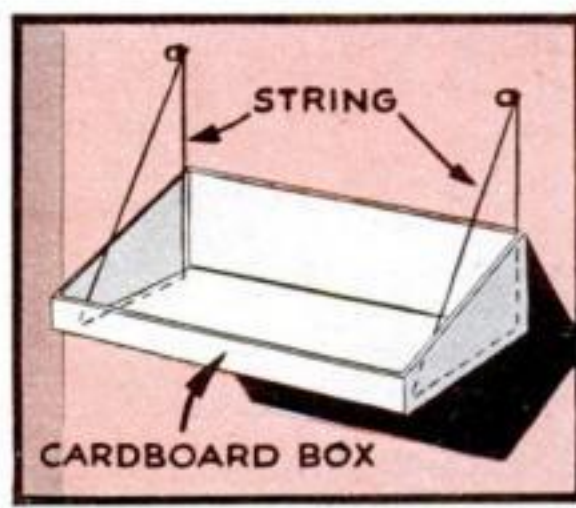
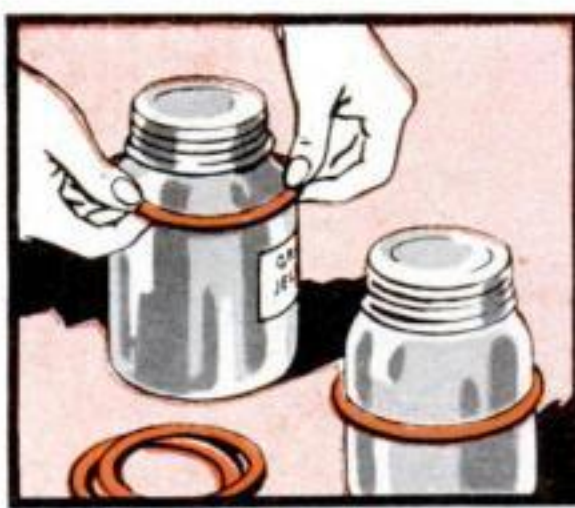
To repair small holes in rubber articles, apply a thin coat of fingernail polish around the break and press down a cotton patch. When the polish is dry, apply several more coats and leave overnight.

Suit boxes, useful for storing blankets and other items, can be shortened to fit into a closet by cutting off the end and using it as a pattern to lay out a new end, including new flaps and slits.

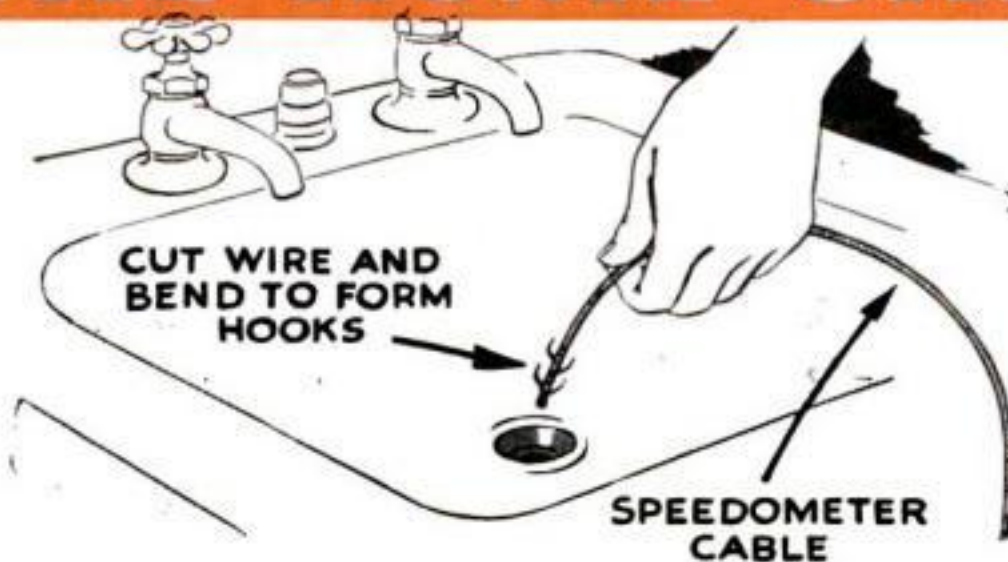
No artistic ability is required to cover small spots and stains on wallpaper with pastel crayons. A good color match is possible.

When packing jars of vegetables or fruits for moving, stretch a jar rubber around each. Jostling then will not break the glass.

If cut down, as shown below, and supported by a heavy string, a cardboard box makes a handy temporary shelf for light objects.

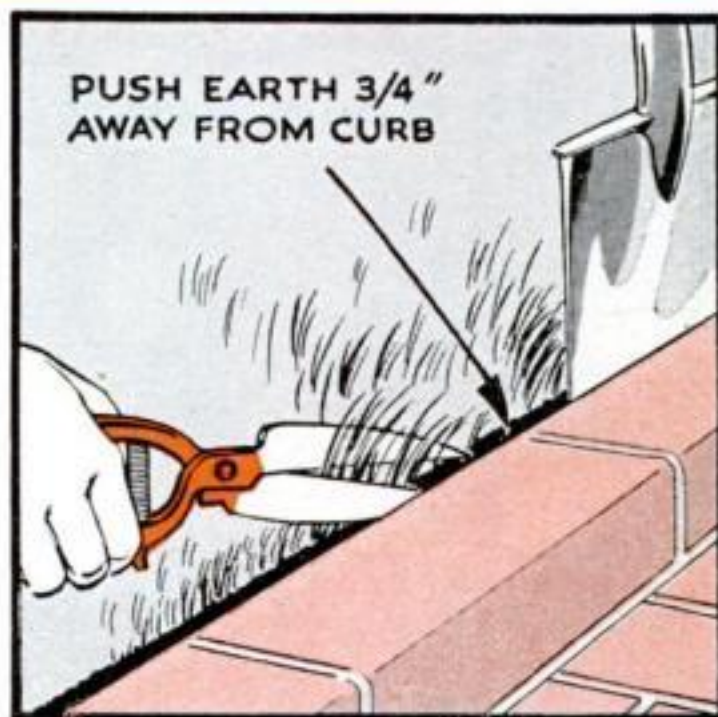


THE HOME SHIPSHAPE

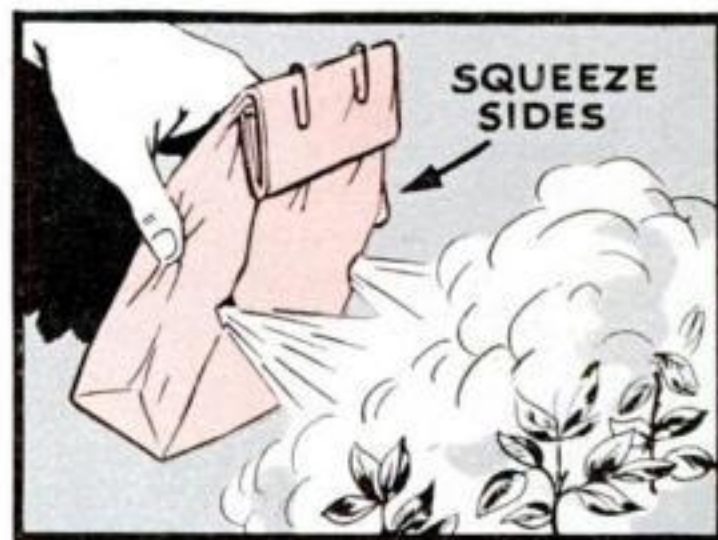
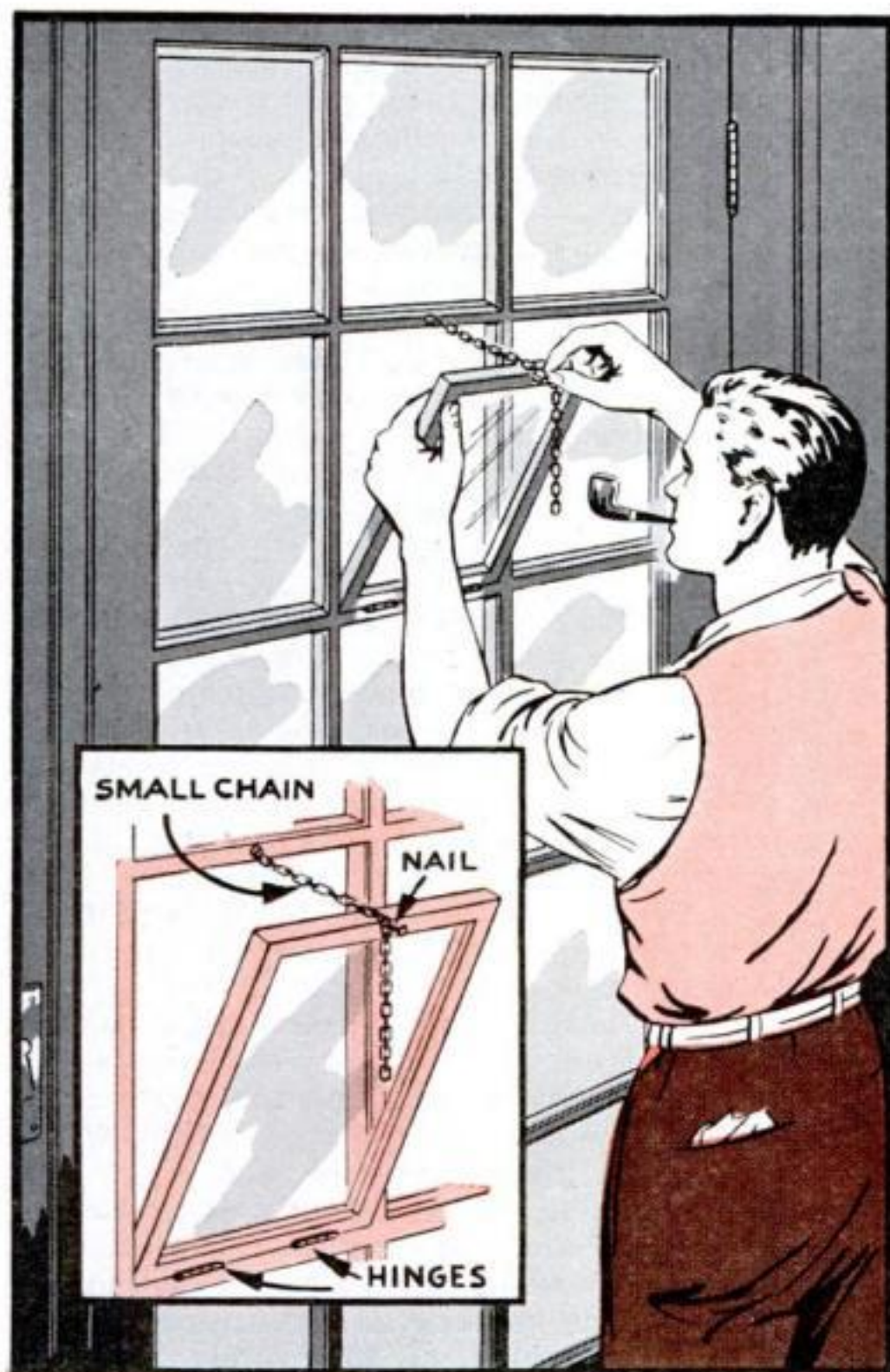


By unwinding 1" or so of the cable wire wrapper of an old speedometer cable and bending it to form hooks, you can make an excellent tool for removing objects from a drain that has failed to respond to customary grease solvents.

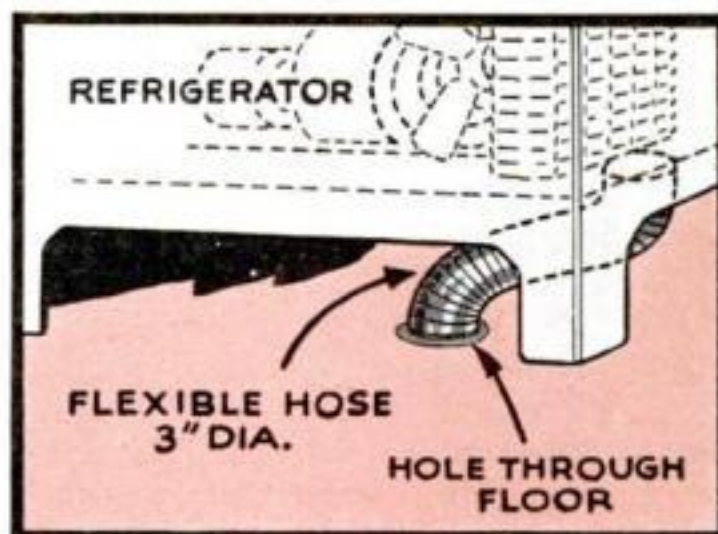
Removal of one pane from a French door and substitution of an adjustable window will ventilate a living room as needed without drafts. A short length of chain permits fastening the window opening in any desired position.



Trimming a lawn is made easier by pushing sod away from the concrete curb $\frac{3}{4}$ " with a flat spade, thus forming a trench along which clippers can move without hindrance.

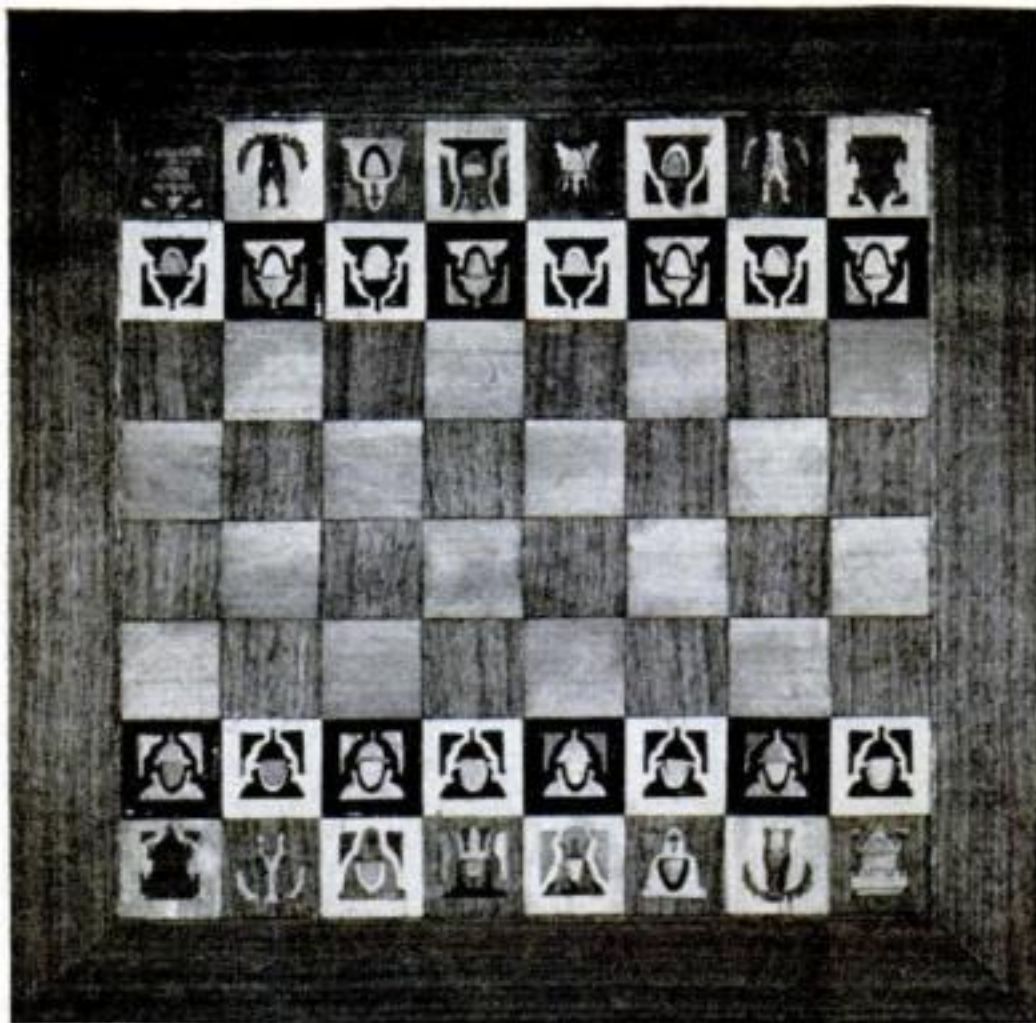


Plant-dusting powder is easily applied in small amounts by squeezing the sides of a paper bag notched halfway up on two edges. Fill the bag one-third full and close.



If thrust through the floor and covered with a screen, a flexible chrome-finished hose 3" in diameter will carry a supply of cool air up to your refrigerator radiator.

MARQUETRY



Thin veneer cutouts make up this richly decorated chessboard.

By EDWIN M. LOVE

RICH decorations suggesting the hand of a master craftsman are possible with the ancient art of inlaying and marquetry; yet anyone who has fair skill with tools can undertake this work with confidence. Some uninvolved designs, especially many suitable for inlays, may well be cut with a hand scroll saw; but for more intricate patterns, such as those on the chessboard shown above, a power jigsaw is essential.

Inlay is a term often applied to both forms of the art. Strictly speaking, however, it means the mortising of cutouts from wood or other materials into a solid ground of wood, while marquetry is a pattern of pieces cut from thin sheets and glued to a backing over which it forms a complete veneer. Putting the pieces together is like working a jigsaw puzzle.

How is inlaying done? Preparation of both the inlay and the ground into which it is to be glued is shown in Fig. 1. Materials $\frac{1}{8}$ " or more thick are generally used for the inlay. Paste a paper pattern on the inlay stock, or transfer it with carbon paper or by other means, and saw out the part. Since waste wood surrounds the piece, there will be maneuvering space for a saw blade as wide as $\frac{1}{16}$ ". Saw in the waste, grazing the line and undercutting slightly.

Press the inlay on the ground and scribe around it with a sharp pencil or a steel point to trace guide lines for gouging out the mortise. If preferred, duplicate paper

patterns can be made at the start and one of them pasted to the ground, or the pattern can be traced on the stock with a carbon. Fit the inlay pieces to their mortises and glue them with plastic or stainless casein glue.

Are fine marquetry woods available? Veneers cut from rare and beautiful woods, usually $\frac{1}{28}$ " thick, are used. They are carried by many dealers. If a suitable variety is difficult to obtain, some pieces may be stained with ordinary water-color paints *after* the project has been completed. Sanding after the stain has dried will flatten raised grain and even the color.

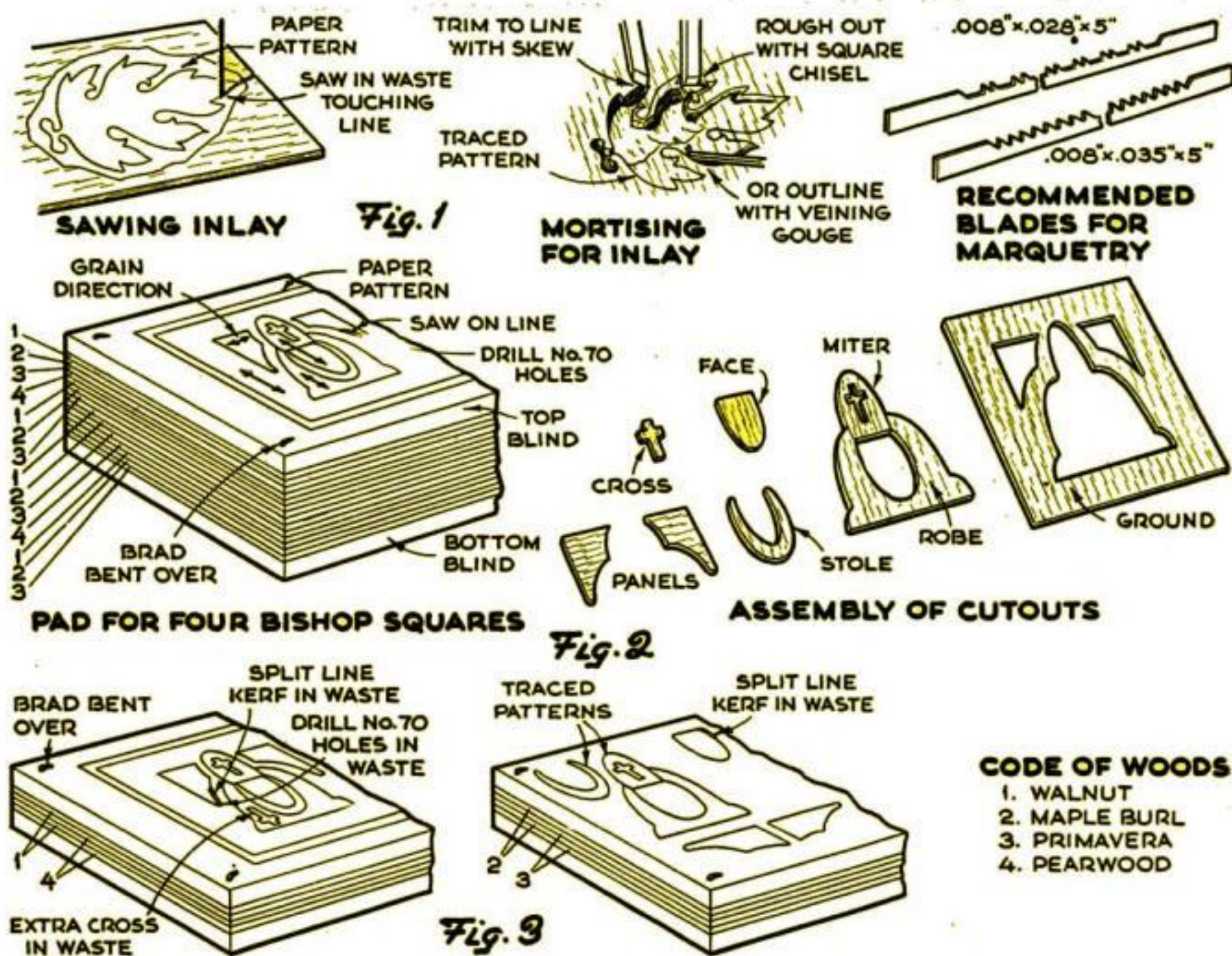
What are the steps in sawing?

There are two common methods of sawing out pieces for marquetry. One involves the stacking of the required veneers in a pad, attention being paid to direction of grain as well as to kinds of wood, and sawing the ground and all pieces from this pad, as in Fig. 2. In this way, regardless of irregularities in sawing, all fits will be accurate, but the corners will be somewhat rounded and fine blades must be used to avoid too wide a kerf. These fragile blades are, of course, easily broken. The other method also requires stacking, but the patterns for the pieces are laid out individually, as in Fig. 3, and waste wood is provided for the kerfs. This assures sharp corners because drilled holes to start the saw will be in waste, but fit will depend on skill in sawing and the amount of sawing is doubled.

The jigsaw blade must be adjusted to cut at exactly right angles to the table. Thread the blade through the starting hole, clamp the upper end in its chuck, and tension the spring just enough to draw the blade straight. An individual guide, which has a narrow tip slit to fit the blade, is preferable to a standard guide because it gives a better view of the work.

For an example of the procedure, consider the chessboard bishop squares. Four such are required, two black and two white, and four different veneers are specified. Walnut, maple burl, primavera, and pearwood are used for the black squares, and walnut, primavera, and pearwood for the white. A black and a white square can be paired in cutting since some parts that are waste for one can be used in the other. This does not

FOR THE HOME CRAFTSMAN

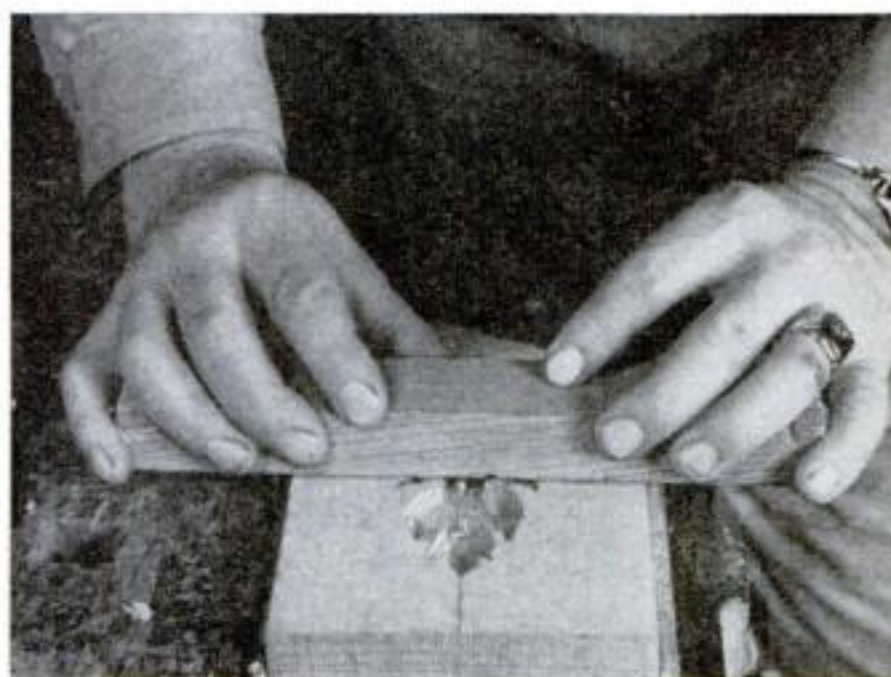
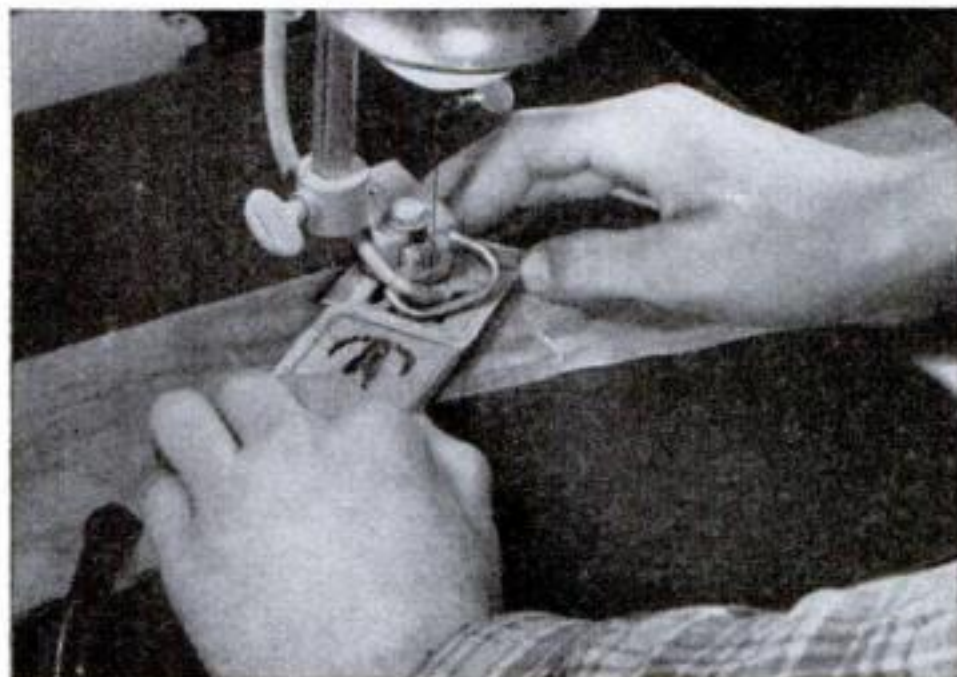


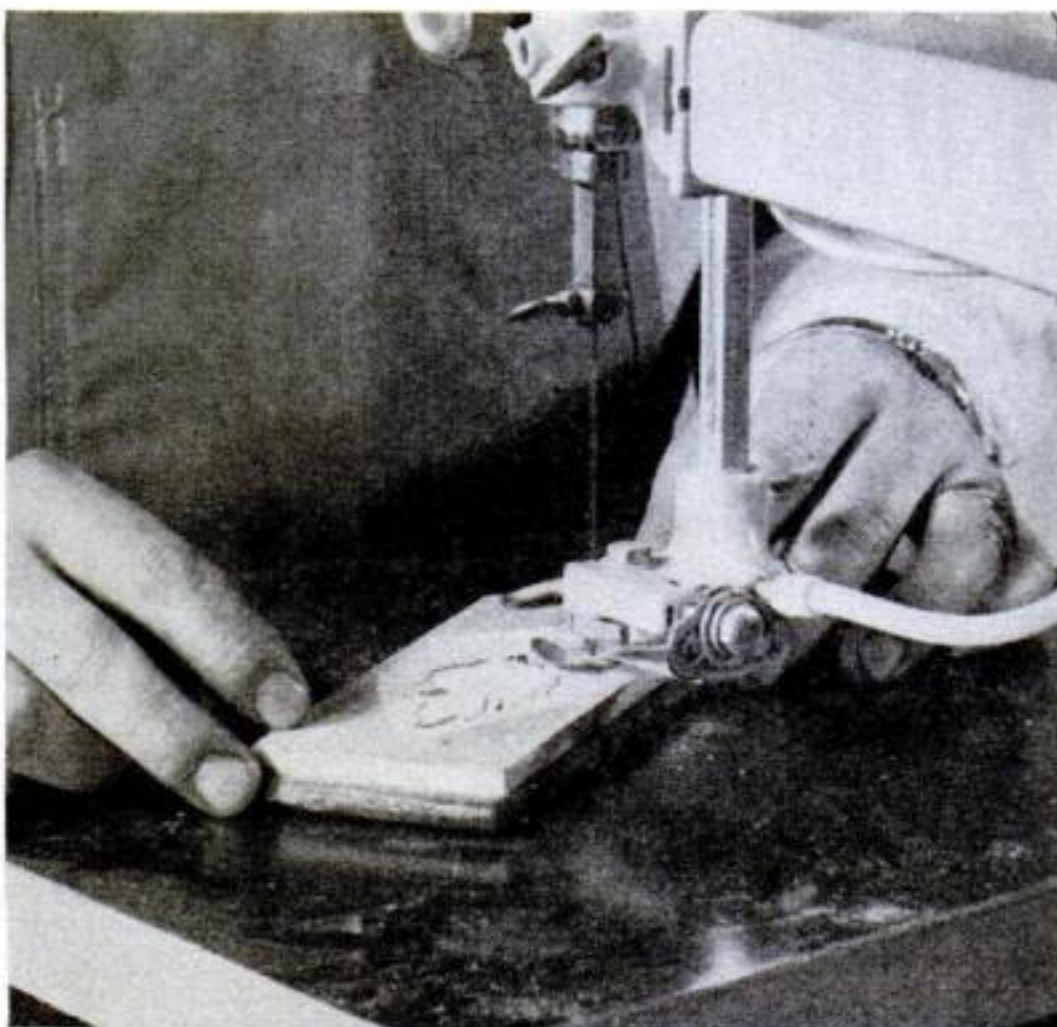
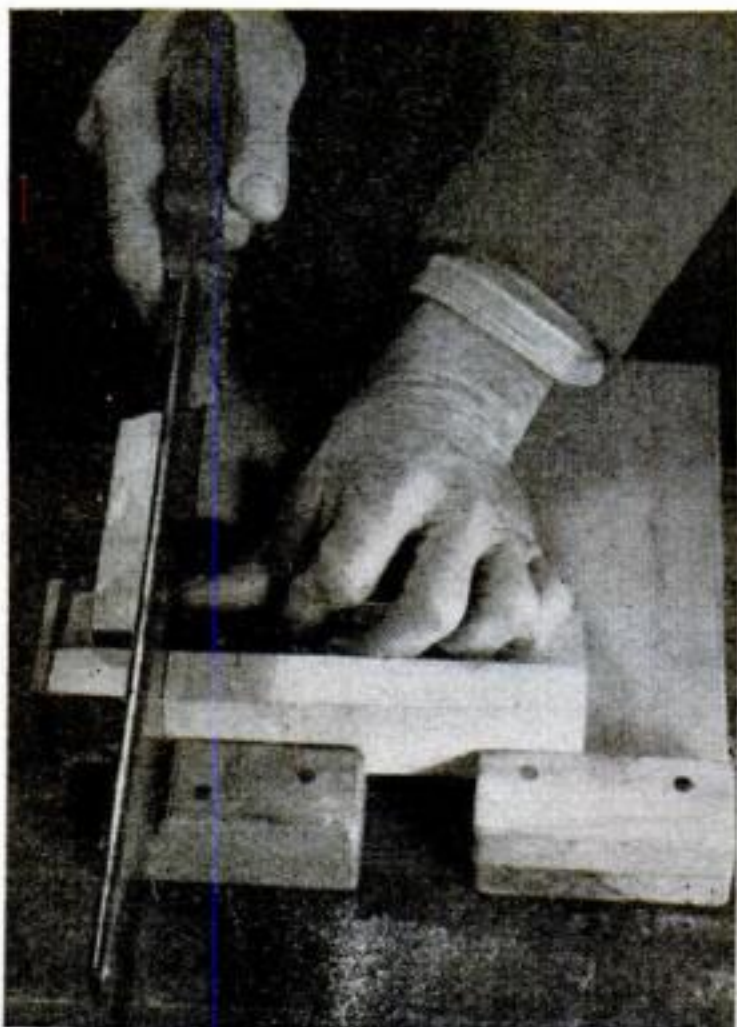
hold true for the cross on the miter, which is walnut for both black and white squares.

A pad for one such pair can be made from two walnut veneers, two maple-burl veneers, two primavera, and one pearwood. The

extra maple-burl and primavera sheets are needed because of change in grain direction, the panels having horizontal grain and the pieces representing miter and robe having vertical grain. A face for the black bishop

Pieces of marquetry and grounds are sawed in pads. The board clamped to the table keeps the parts from falling through. At right, a screwhead protruding from a block routs the bottom of an inlay mortise.





Plain squares for the chessboard assembly are cut to size in a miter box. Taper sawing, as at the right, compensates for saw kerf. Inlay and ground are cut from a double thickness, and only one of each used.

is cut from the same pearwood veneer that provides the ground for the white, and a second pearwood sheet is unnecessary.

Since four bishop squares are called for, the requirements are doubled, and a pad with 14 pieces of veneer instead of seven is stacked and sandwiched between top and bottom blinds of thicker veneer, as shown in Fig. 2. All grain direction will be vertical except for two maple-burl and two primavera sheets. Hold the pad together with thin brads driven in waste wood at the four corners and bent over at the top.

Drill a small hole in the sharp corner in each piece for starting a fine saw blade, and then saw out one piece at a time, being sure to saw exactly on the line. The procedure is something like this: Cut one panel, remove the work and the saw guide, and pick out the pieces, putting in individual boxes those required for each bishop square and discarding the waste. Then cut out and sort the other panel; then the cross, next the face, next the stole, and finally the miter and robe in one piece. This leaves the ground, which needs now only to be trimmed on the outside edge.

Two pads are required for the method illustrated in Fig. 3, one for the ground and one for the marquetry pieces. Make up the one for the ground with two walnut layers and two of pearwood, and lay out on it the pattern for the background, the face, the stole, and two crosses. Space for the second cross can be found in waste wood in one of the panels or in the robe. Saw out the small pieces first and then the outline for

the ground, splitting the pattern lines in the center and putting the kerf in waste. Retain the four grounds, two pearwood and two walnut crosses, two walnut stoles, and two pearwood faces, and discard the rest.

The second pad is made up of two sheets each of maple burl and primavera. On it are laid out one pattern each for the left and right panels, the face, the stole, and the miter and robe, the last being in one piece. Lay them all out with vertical grain except the panels, which should have horizontal grain. Saw as before, splitting the guide lines and putting the kerf in waste. Keep all the panels and miters and robes and the primavera faces and stoles. The maple-burl faces and stoles are not needed.

Designs for the other decorated squares are given in Fig. 4. All are made on the same principle.

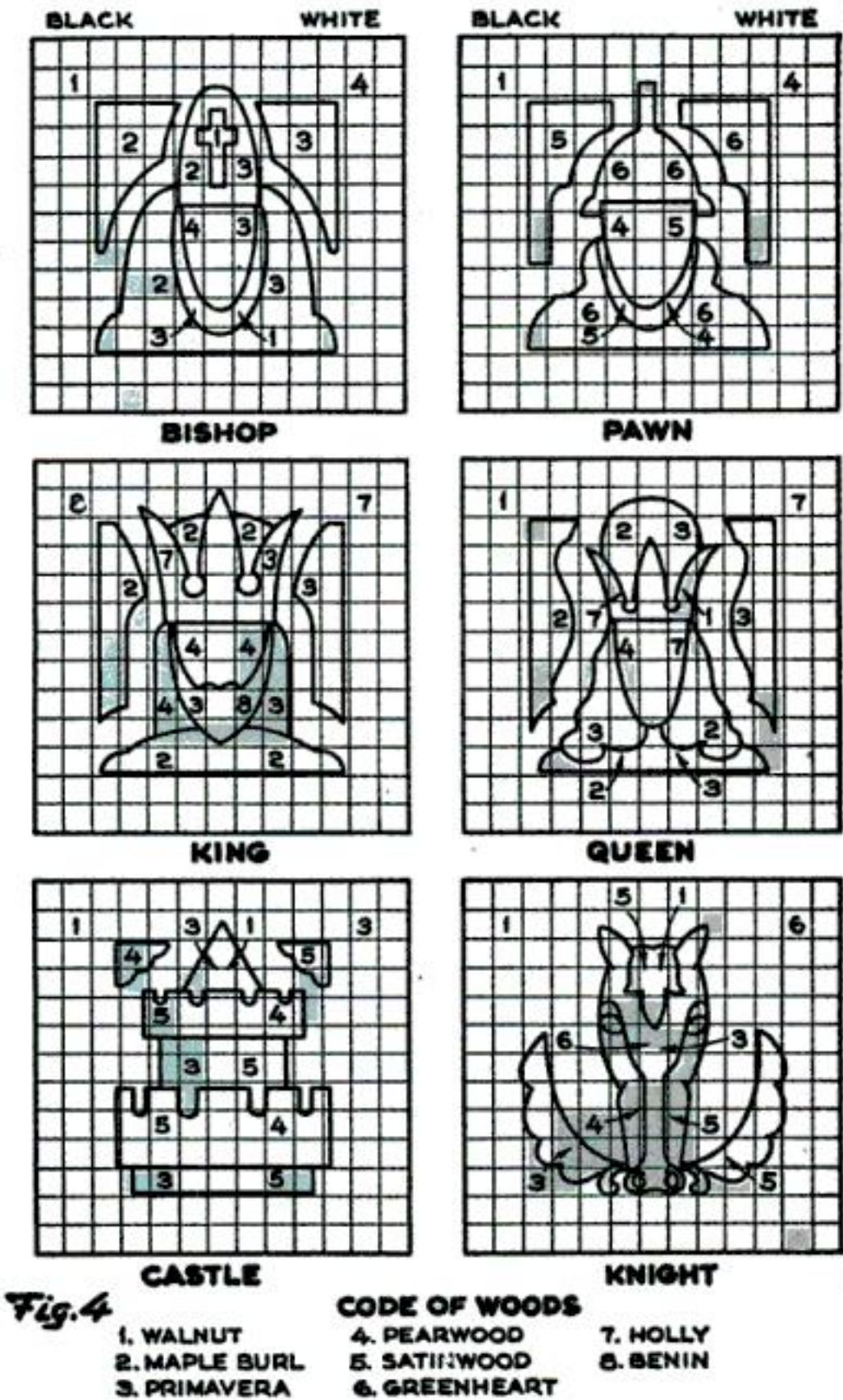
How are plain squares cut? Walnut and pearwood veneers are sawed approximately to width for the 16 dark squares and the 16 light. Strips are clamped together for jointing the edges of each and are cut to length in a miter box, as shown in the photo at left above. While still clamped they are also cut to exact width.

Is assembly difficult? The parts for each decorated square are put together like a jigsaw puzzle, spaced evenly at the joints, and pasted on strong paper. Plastic composition wood or a mixture of glue and fine sawdust is then rubbed into the joints. The squares are next pasted on a paper layout of the chessboard, which has been fastened with tape or thumbtacks to a wide board. As-

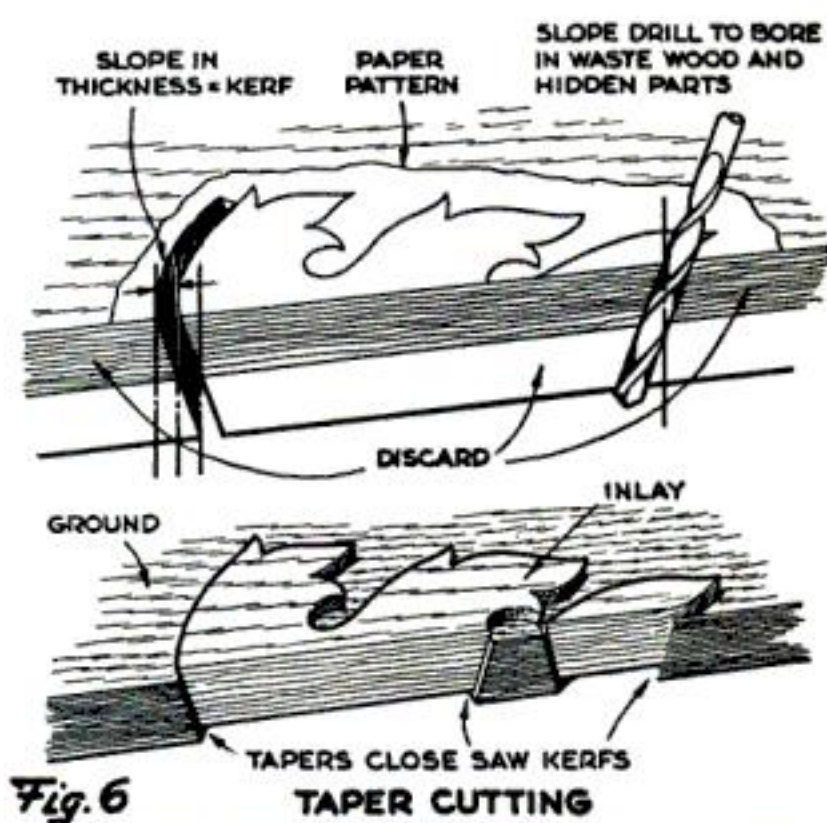
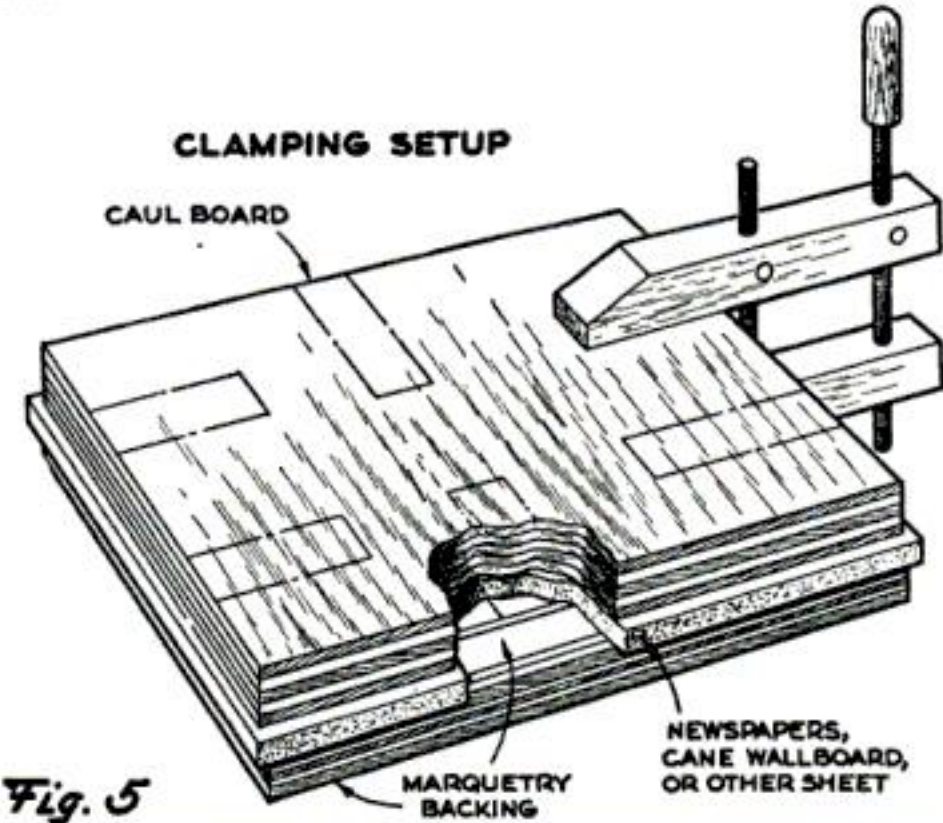
sembly should begin at a corner, and the edges should be fitted with a block plane and cabinet file. After all the squares are in place, the outer edges can be jointed by loosening the paper, sliding the edge a little beyond the edge of the board, and clamping another board on top so a jack plane can be used. The paper backing is folded down out of the way while planing is done. The border strip or strips selected for the chessboard are attached next.

Before gluing the marquetry to its backing of heavy plywood, paper is pasted on the top of the assembly and weighted, and when this has dried, the paper on the bottom is dampened and pulled off. Gluing is done in clamps with newspapers or the like and a caul board of $\frac{3}{4}$ " plywood covering the face, as in Fig. 5. Slight unevenness that may show when the papers are sponged off can be trued by light sanding, which should be with the grain wherever possible. The light woods are coated with white shellac before finishing. Periodic light applications of wax will help keep the board in good condition.

Can perfect inlay joints be assured? Taper cutting, as shown in Fig. 6, is one method. If the saw table is tilted at the correct angle, the upper piece will wedge into the ground and compensate for the saw kerf. Only one inlay and ground can be cut at a time, and several gluing operations will be required if inlays are in a variety of colors. In general, the quality of inlay joints is governed by the care and skill that are used in sawing out the parts.



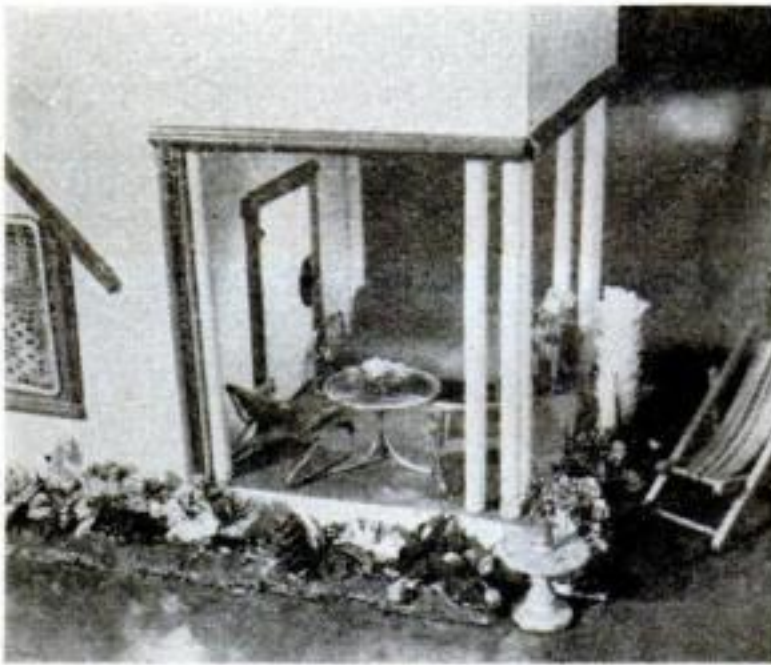
Gluing marquetry to a backing is done under a pad and caul. Taper-cutting procedure is shown at right.



DOLL HOUSE DE LUXE

WHEN 14-year-old Sally O'Neill sets to work to clean house, that is, her doll house, it takes a good five or six hours to dust all the tiny fittings thoroughly. The house is 4' by 8' and has three stories, 11 rooms, a roof garden, a garage, and a recreation room. It is divided in the middle to provide access to all rooms.

Sally's mother, Mrs. Cecelia O'Neill, of Newark, N. J., shown in the picture at right, began building the house and its furnishings four years ago.



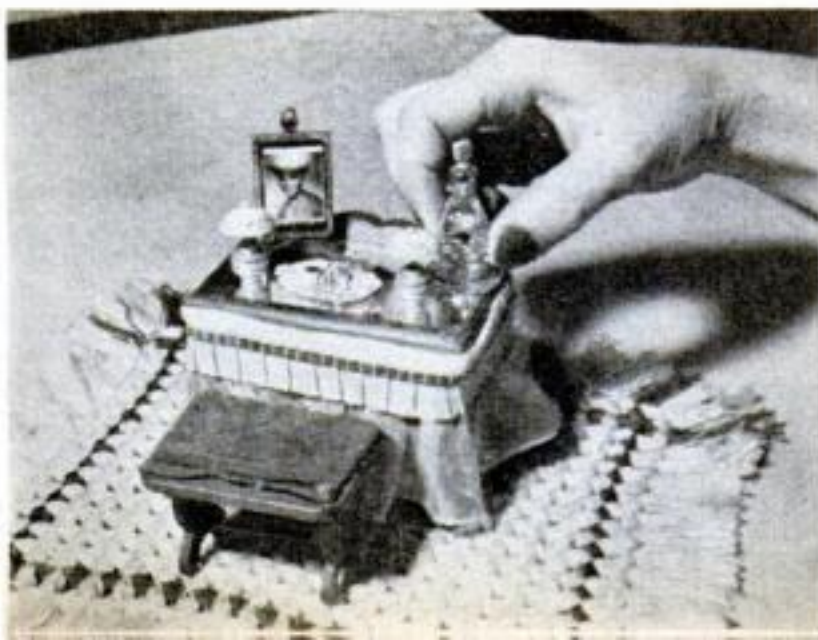
Brightly colored flowers in a 2" wide bed border the side porch of this elaborate doll house. Note the porch furniture built in the best modern style, each piece an example of the careful work found throughout the house.

How complete the house is in fine detail is shown by the grouping below. The photo on the dressing table is no larger than a postage stamp, and the boudoir lamps, the perfume bottle, and tray are all in scale.



This game table, set up for bridge or chess, is barely a cigarette length in width—that's a cigarette lying across its top. It required many hours of work to build such furnishings in the quantity necessary for the mansion.

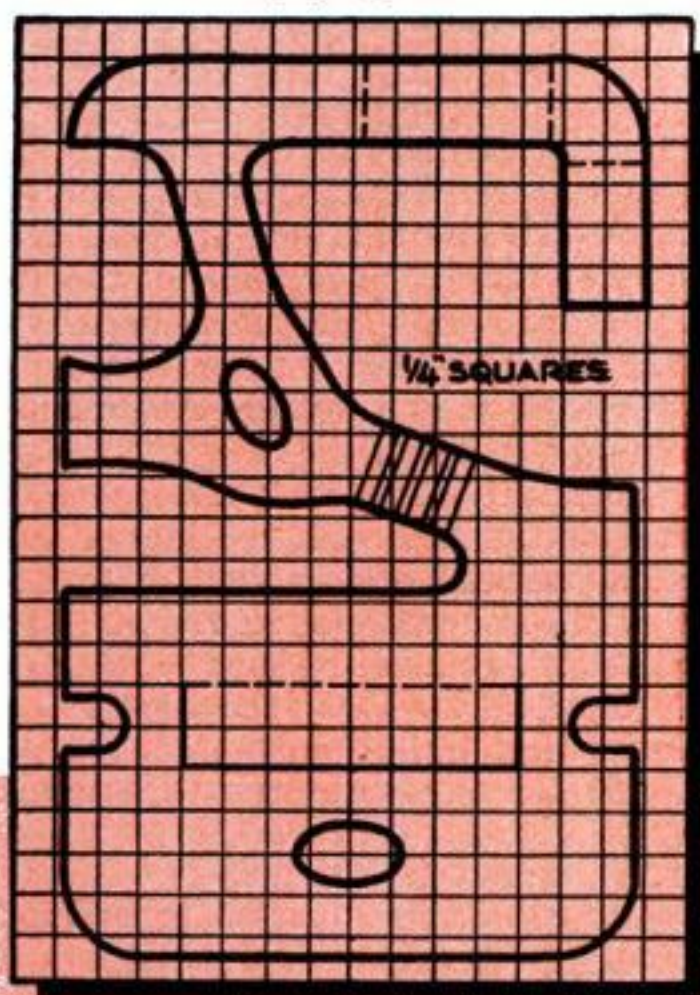
In the room below, there is even a basket of logs ready to place on the andirons in the handsome fireplace. The rug was part of an old fur collar and looks like real bearskin. Logs were formed of twigs cut to scale length.





Pocket Golf Course Will Plumb Your Patience

Lay out a grid of $\frac{1}{4}$ " squares large enough to accommodate a rectangle $3\frac{1}{2}$ " by $5\frac{1}{2}$ "; then draw on the playing surface as shown.

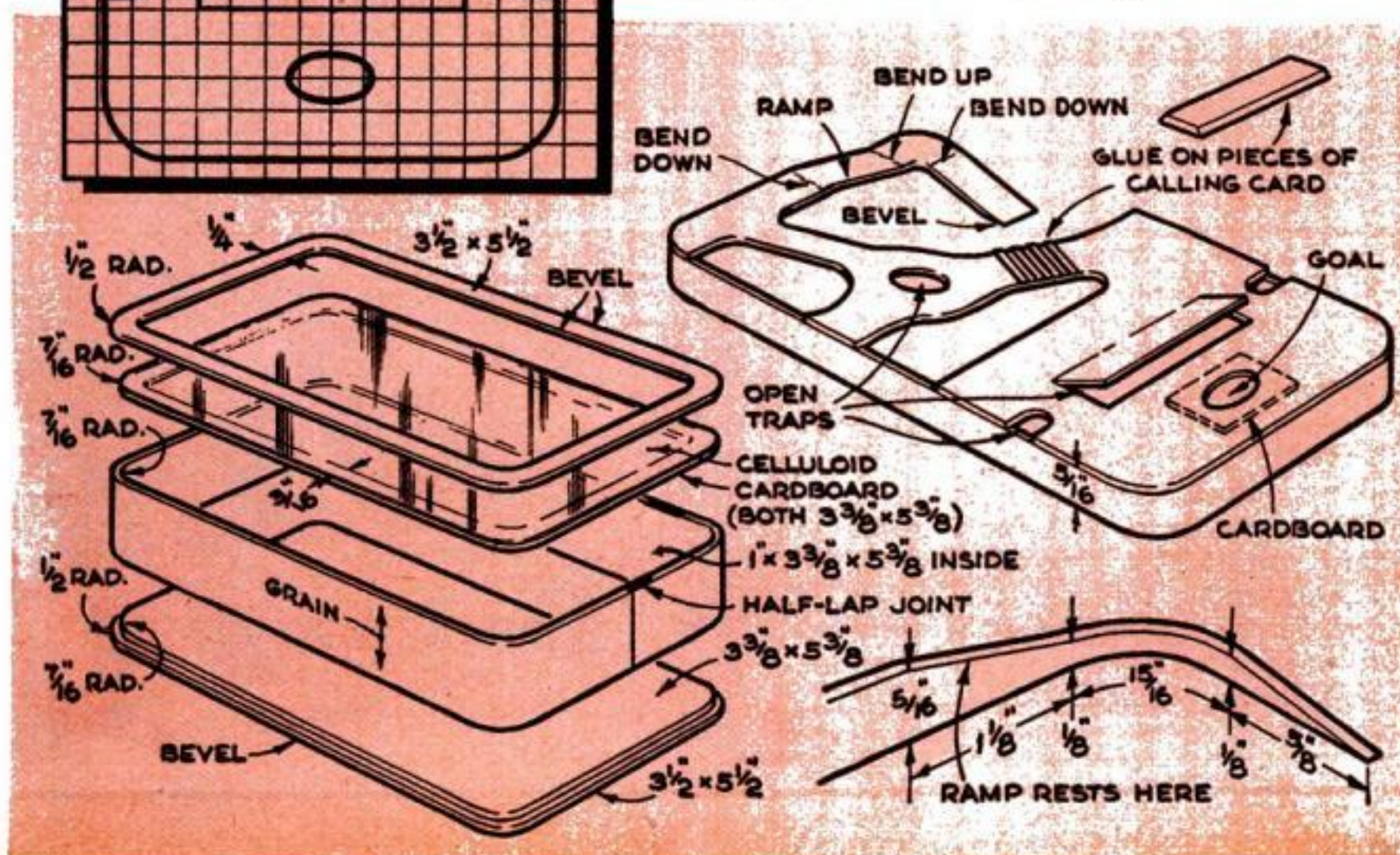


WHEN your head begins to spin, you may just as well quit trying—but you won't. Rolling the ball on the tortuous path to its goal requires a keen eye and a steady hand.

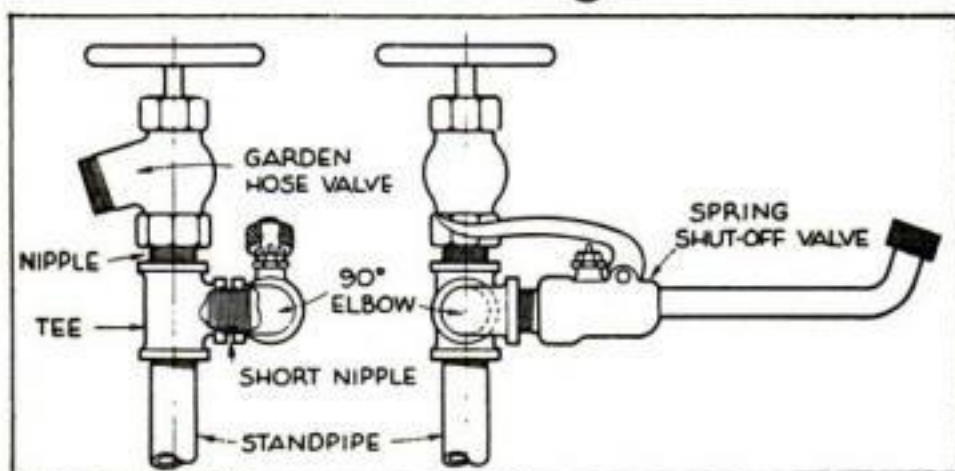
The game is made of 14-ply show-card board. Cut the individual parts with a sharp knife and a metal-edged ruler. Make the playing surface of the same kind of material as the case, but you will find a lighter shade preferable. Smooth all edges with fine sandpaper.

A strip of cardboard should be glued underneath the oval goal opening. In making the bunker, cut half through the underside, bevel the edges slightly, and apply a coat of glue to the shallow groove. The bend in the ramp should be similarly treated. Finish with several coats of floor wax.

The single moving part consists of a $\frac{3}{16}$ " bearing ball. If it proves too difficult to make the goal, a slight groove may be drawn along the path of the ball; another alternative is to assign partial values to the intermediate traps.—FRANK SHORE.



Shutoff Nozzle on Water Pipe Is Garden Drinking Fountain



ANY amateur plumber can install this drinking fountain on a lawn or back-yard pipe and solve the problem of thirsty children trooping in and out of the house during warm weather. The kids will love it, mother will be relieved, and it will be handy for thirsty gardeners, too. The faucet itself is a grip shutoff nozzle inverted to create a fountain stream. It will be recognized as the type used at gasoline stations



for filling radiators. The nozzle is attached to the standpipe with a 90-deg. elbow and a tee below the garden-hose valve.—KENDRICK M. MARTIN.



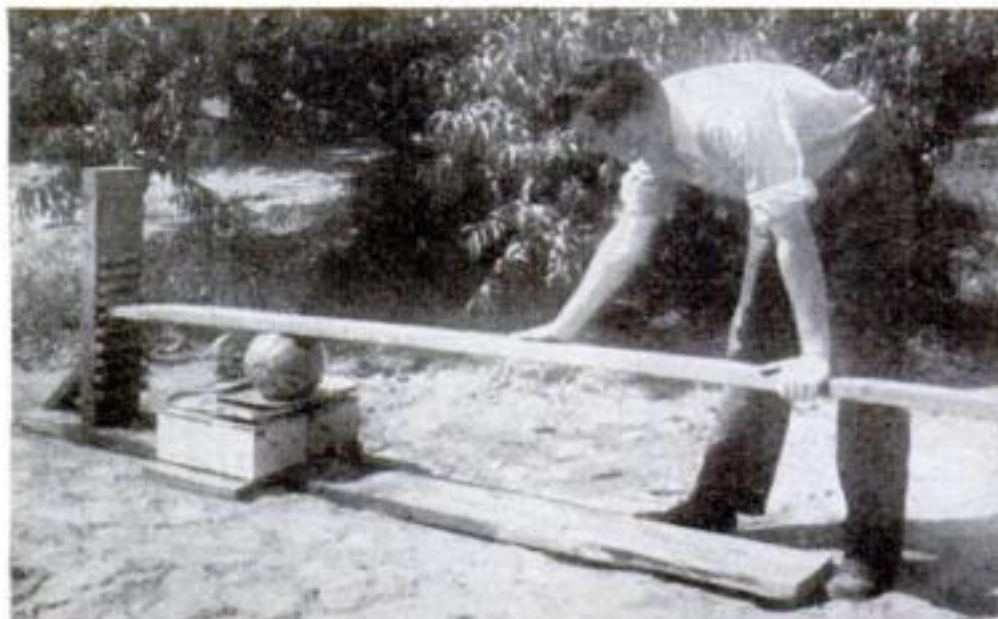
SIPHON TUBES of transparent plastic are being used successfully by irrigation farmers in the West to carry water direct from the lateral without cutting the ditch bank as in the past. When one field or part of a field is irrigated, all the farmer has to do is pick up the tubes and reset them in another spot. The tubes, usually 36" long with a diameter of 1" to 2½", can be bent to any needed angle when heated in hot water. After cooling they retain the shape given them.

Almost perfect results are attained if the water is 4" to 6" above the level of the field and the lateral has a fall of 1" to 100'. The tubes work as well in soft field laterals as they do in the sodded ones at the end of the field, making it possible to reduce the length of the run by using frequent cross-field laterals. Farmers who are using the tubes report that irrigation labor costs have been cut as much as 50 percent.—ARTHUR W. EMERSON.

WATERMELON RINDS are measured for breakage resistance at Cornell University with a device operating on the principle of a nutcracker. The method was developed by scientists who have been crossing watermelon varieties in an effort to produce a tough-rind Honey Cream, which is a popular-selling melon in New York State.

To pick out the melons that have a tougher hide than the parent stock, the scientists use a plank as a lever and apply pressure until the melon bursts. Scales under the melon register the force in pounds at the time of breakage. Results so far show no relation between the size or

ripeness and the force needed to break the fruit. The experience of some shippers also suggests that breakage resistance is an independent characteristic.—JAMES S. KNAPP.

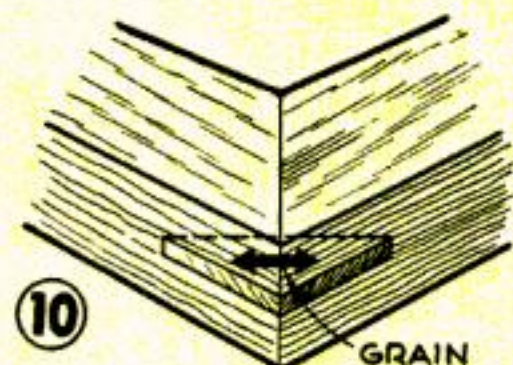
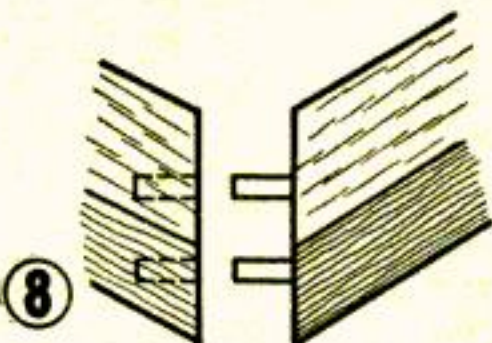
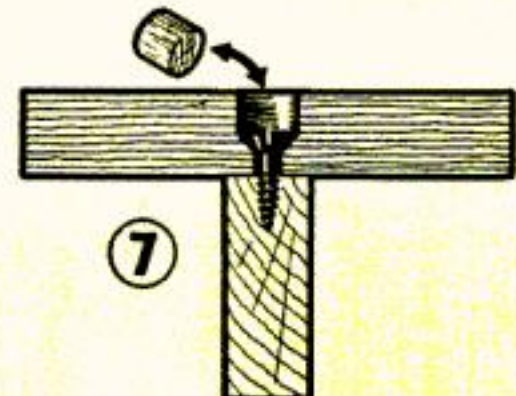
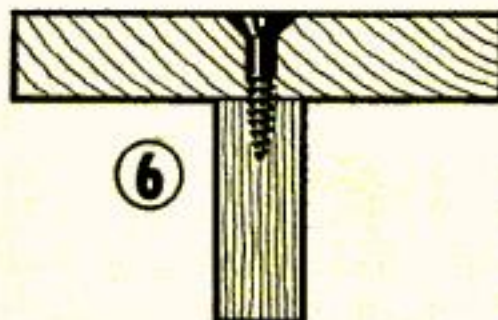
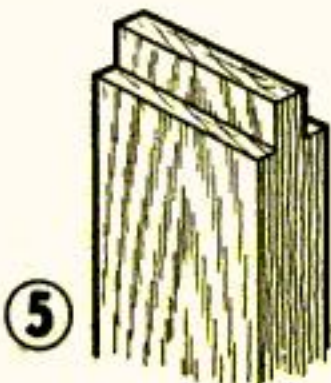
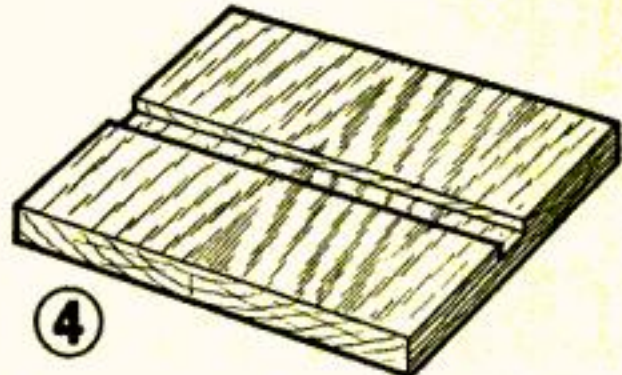
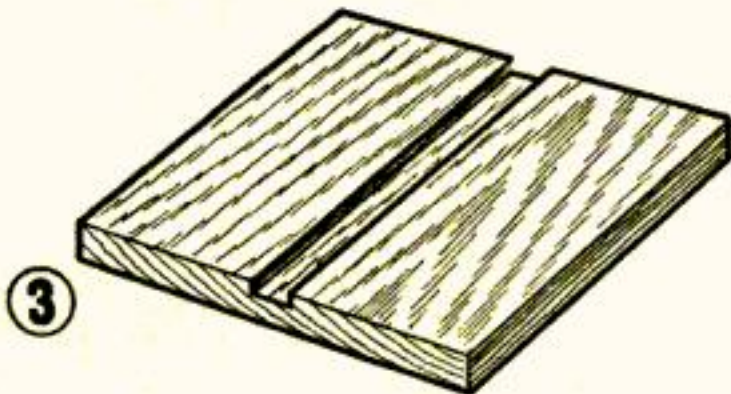
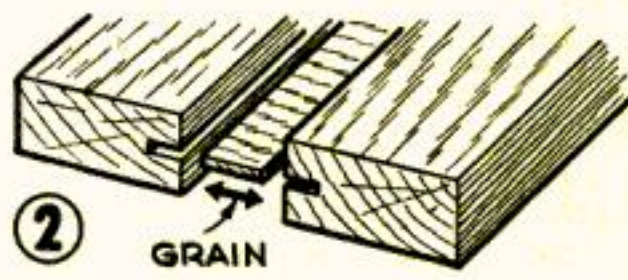


Quiz Yourself

on These Woodworking Terms

FIRST you take the whatchamacallit and cut a 6" thingamajig across the whosis—why, what's the matter? Don't you understand simple English? Well, as a matter of fact, shop-talk sometimes

does sound like double-talk because you can't find just the word you want. For example, how would you describe the details below? Don't stand on your head for the answers—turn the page over.



ANSWERS: 1. This is one variety of the type of joint known as a rabbet or ship lap. 2. Next time you glue up a table top, try this spline joint. 3. You're in the groove if you got this one right. 4. Similar to a groove, except for the direction of the grain, is the dado. 5. A cross-grain tongue is called a tenon. 6. A screwhead set into a chamfered hole is said to be countersunk. 7. A countersunk hole is one that has two diameters, the larger receiving the head of the screw and a fitted plug that conceals it. 8. Corners cause enough trouble without having to name them, but this effective joint is known as the dowel miter. 9. The spline miter also gets its name from its two component features. 10. Similar but simpler is a slip-feather miter.

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LILLIPUTIAN LIBERATOR

B-24 . . . Our Air Force's Giant Four-Motor Bomber in Miniature



With a bomb capacity of well over four tons, the Liberator has no peer as a machine of destruction.

By **JOHNNIE CASBURN**

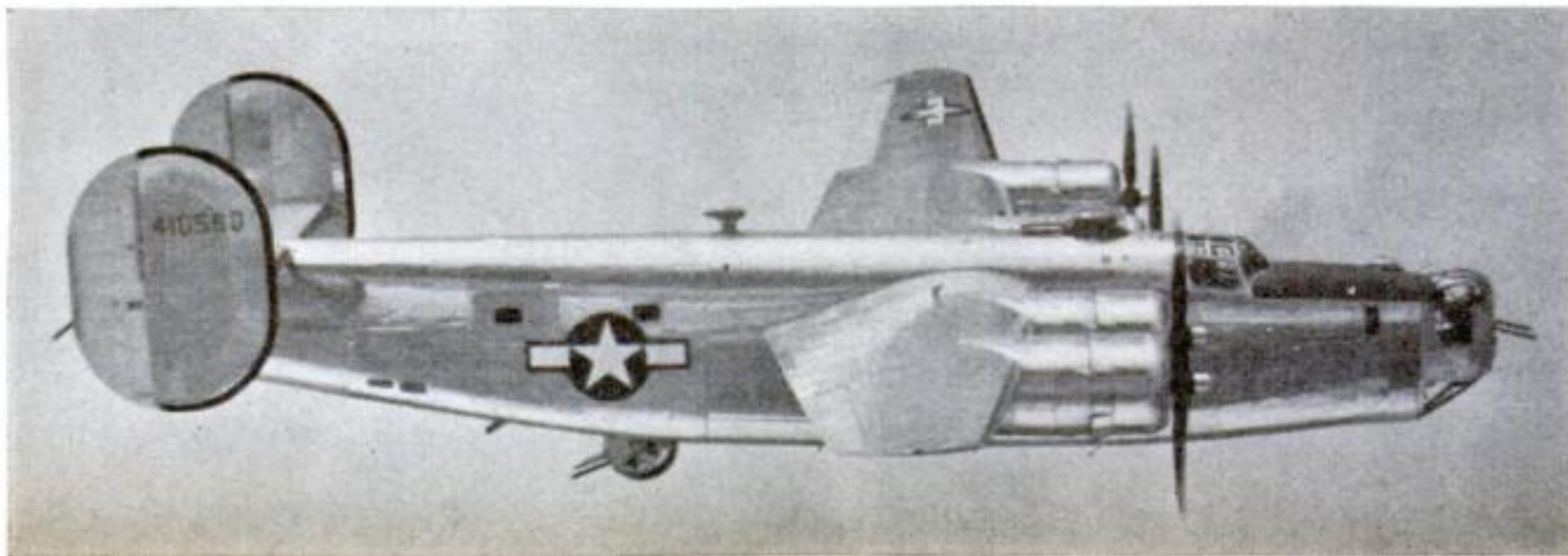
CARRYING a heavier bomb load farther and faster than any other American bomber of the same size, the Liberator has been of yeoman's service to our armed forces. Winging its way across flak-filled skies, it has carried out countless missions against the enemy. It is powered with four 14-cylinder 1,200-hp. Pratt and Whitney engines and has a Davis wing with a span of some 110'. These combine to give a top speed exceeding 300 m.p.h. A bomb load of well over four tons can be carried on flights to distant targets. Designed especially for long-range bombing, the B-24 has a service ceiling of 35,000' and a range reaching beyond 3,000 miles.

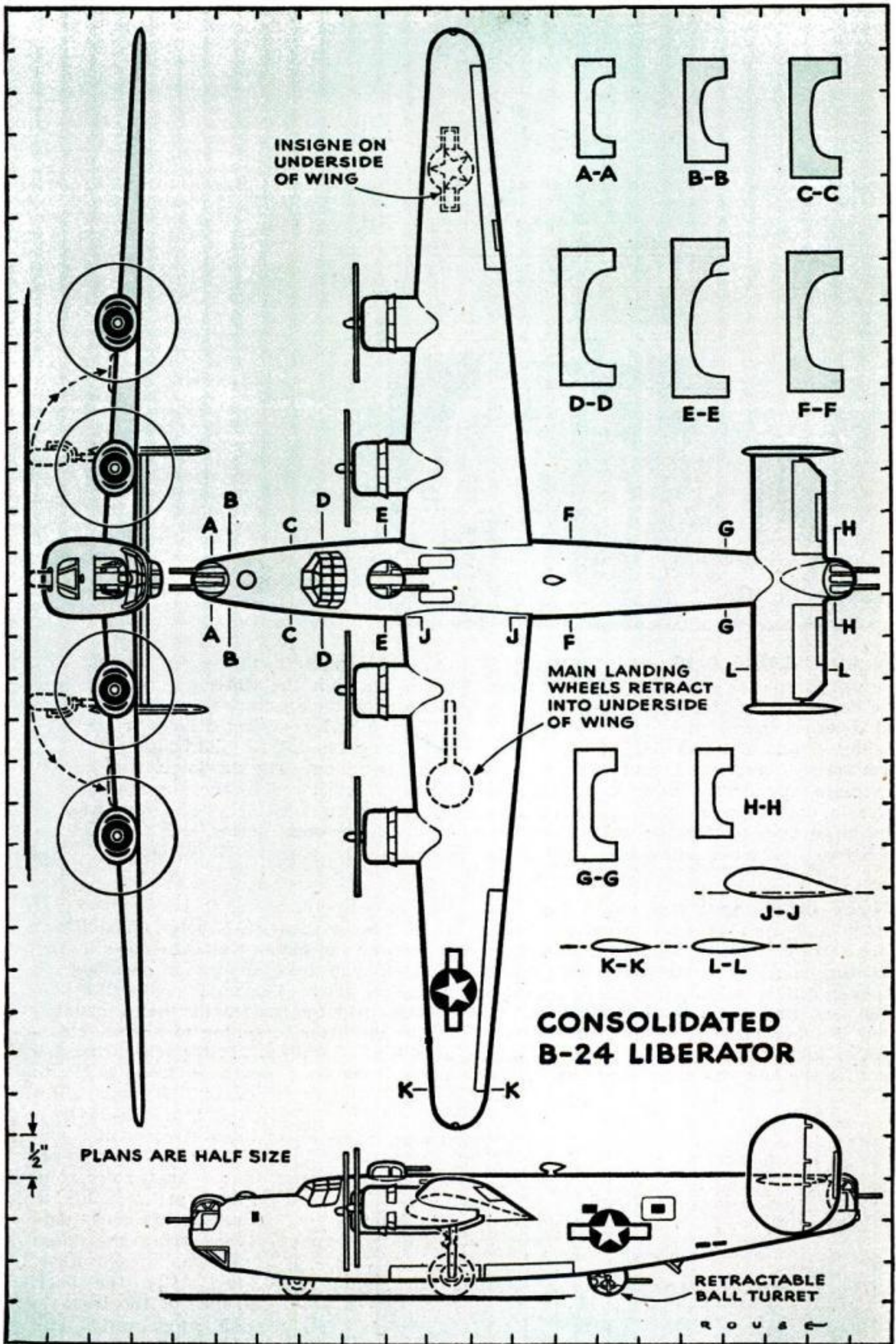
The model can be made of white pine, balsa, or any other soft wood. Follow the procedure described in previous articles in this series. Fashion the engine nacelles and

the gun turrets separately, not as integral parts of the wing and fuselage. Use model-airplane cement to hold the component parts together and plastic composition wood at the joints to form fairing fillets.

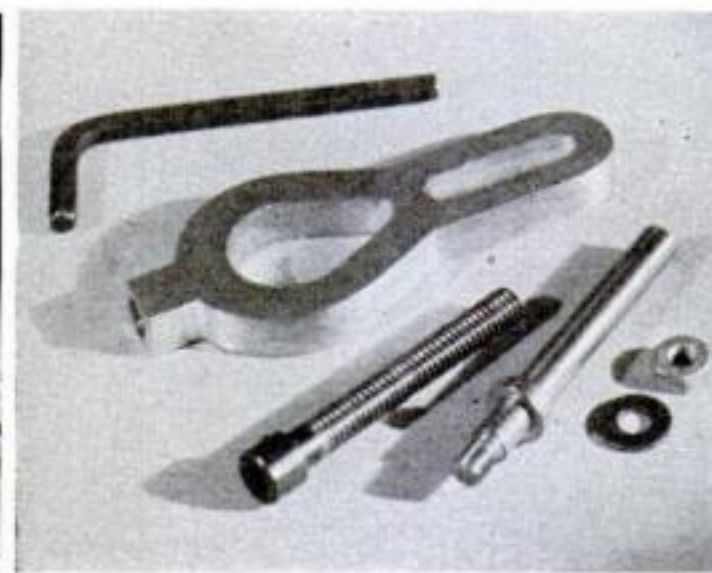
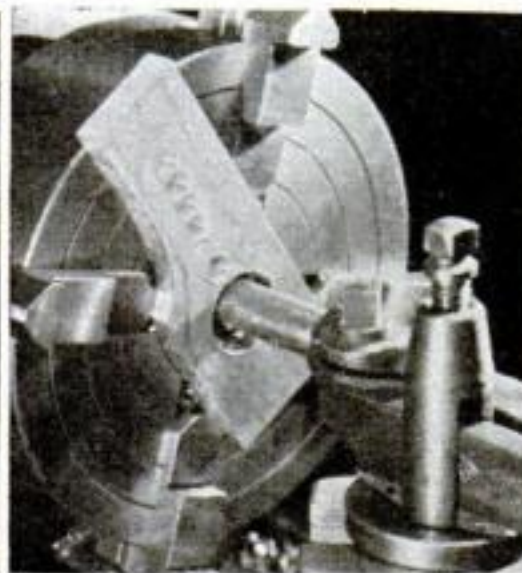
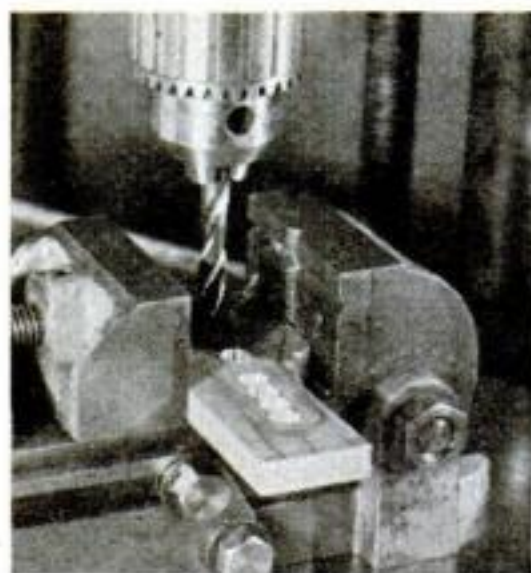
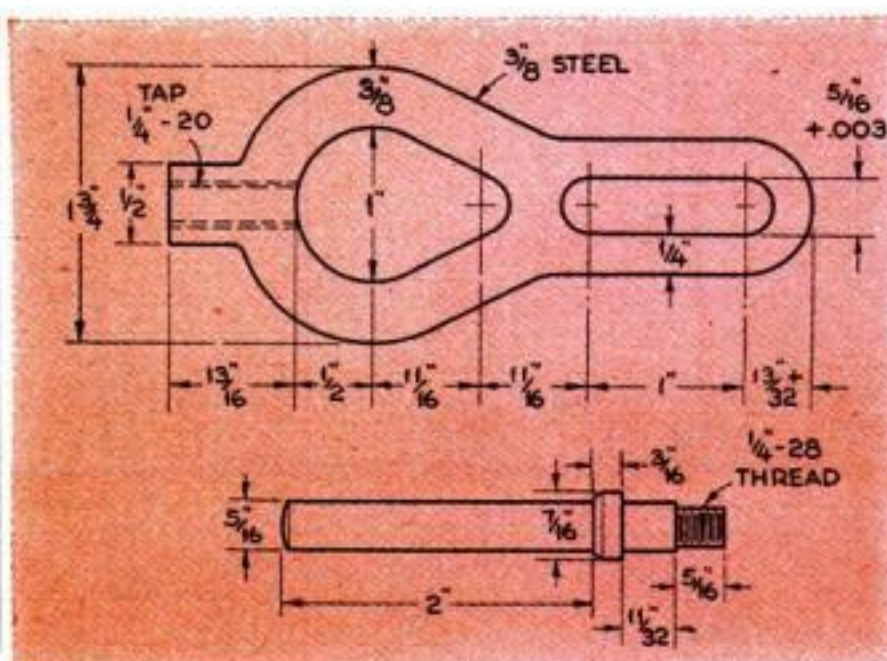
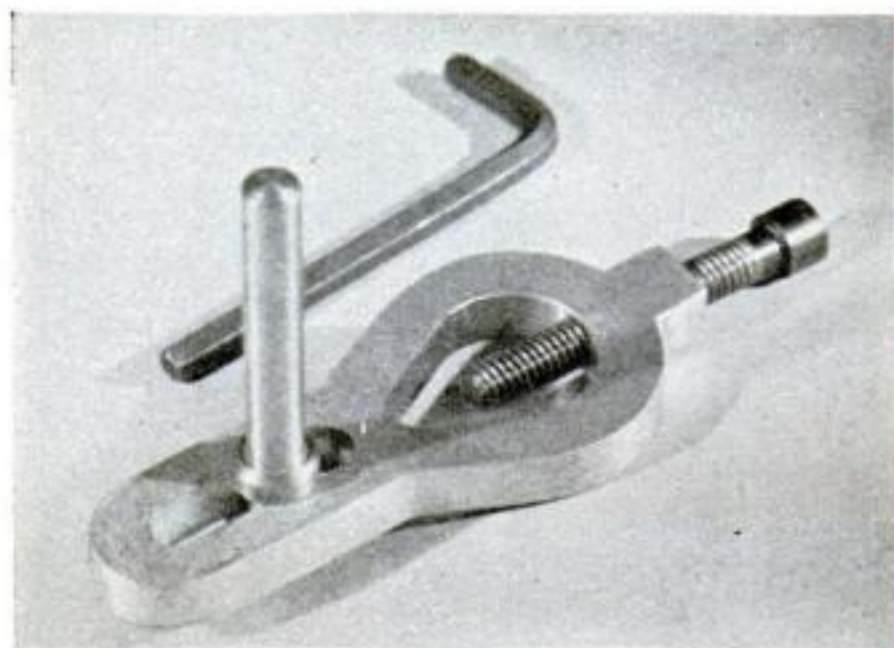
The gleaming-smooth finish that you have admired in professionally built models is not difficult to reproduce. You will need some 400 wet-or-dry sandpaper, some white surfacing putty, a bottle of clear lacquer or dope, some pyroxylin primer surfacer, and a bottle of aluminum lacquer or dope. The sandpaper, dipped in gasoline or water, is used after each step in the finishing process. Fill all small holes and cracks with white surfacing putty; then apply two coats of the clear lacquer or dope. Next, put on coat after coat of the primer surfacer, sanding between coats, until you have a hard, slick surface. Finish with several layers of the aluminum lacquer or dope, again sanding between coats. Thin lacquer before using.

Huge and formidable, the B-24 has earned its spurs both over war-torn Europe and in the South Pacific.





NEW SHOP IDEAS



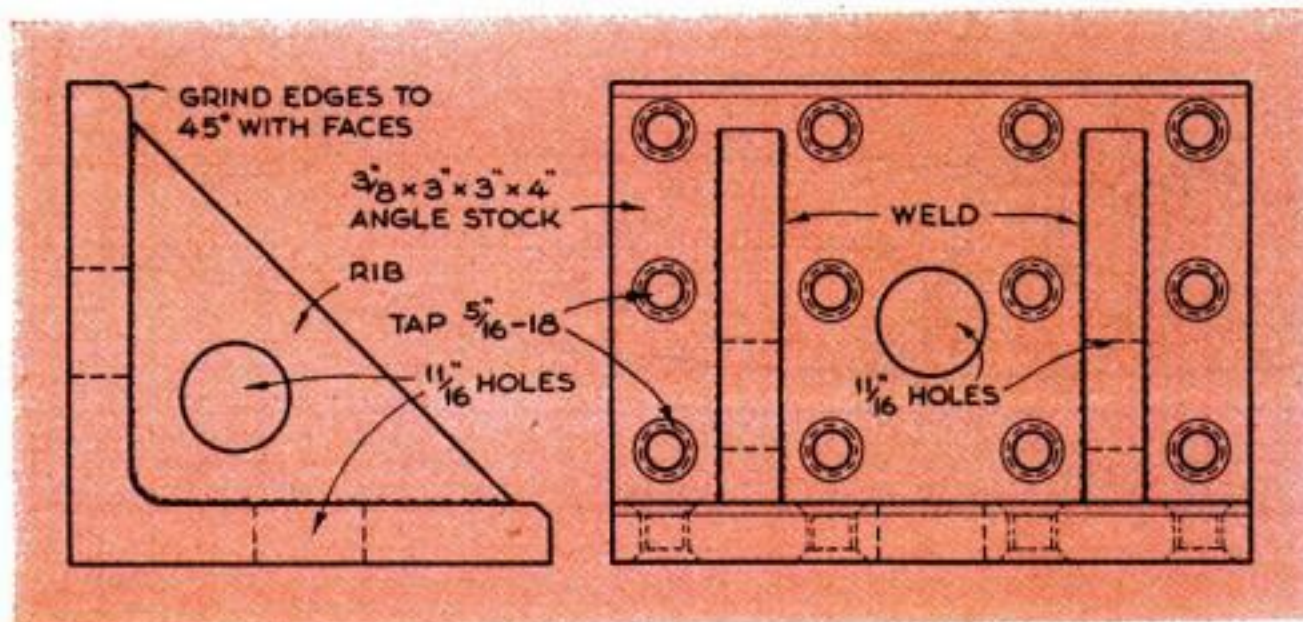
AN ADJUSTABLE DOG comes in handy if you use faceplates of several different sizes. The one shown in the photos above may be put together from a piece of $\frac{3}{8}$ " steel plate, a short length of steel rod, and a hollow-head screw. Draw the layout of the dog on the plate and drill a row of overlapping holes in the tailpiece, as at the left above. The large opening for the work is located with two additional holes, after which the

piece is mounted in the four-jaw chuck and bored out, as in the center photo above. The slot and center aperture are then opened out with a file. By sawing closely to the outline, bring the dog to final shape and finish it off by filing. The driving tail is turned from $\frac{1}{2}$ " steel rod to the dimensions indicated and threaded $\frac{1}{4}$ "-28. A nut, washer, $\frac{1}{4}$ "-20 hollow-head screw, and wrench to fit complete the job.—C. W. WOODSON.

ANGLE IRONS that will retain their accuracy and usefulness for years are worth some extra effort in making. Cut them from structural-steel angle stock and weld a pair of steel ribs in each. Heat them to about 1,300 deg. and allow to cool slowly to relieve welding stresses. Next, plane them square, including the ends, and drill and chamfer the holes as in the drawing. These

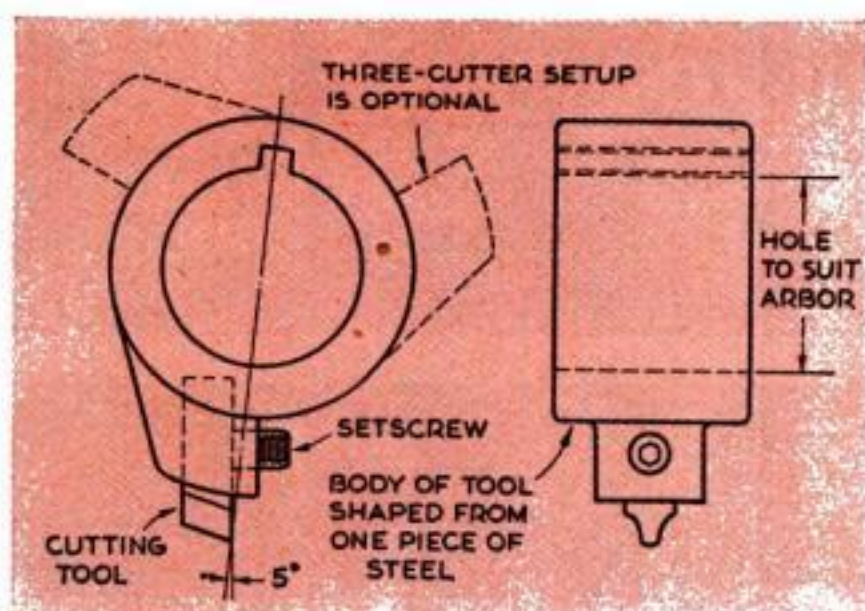
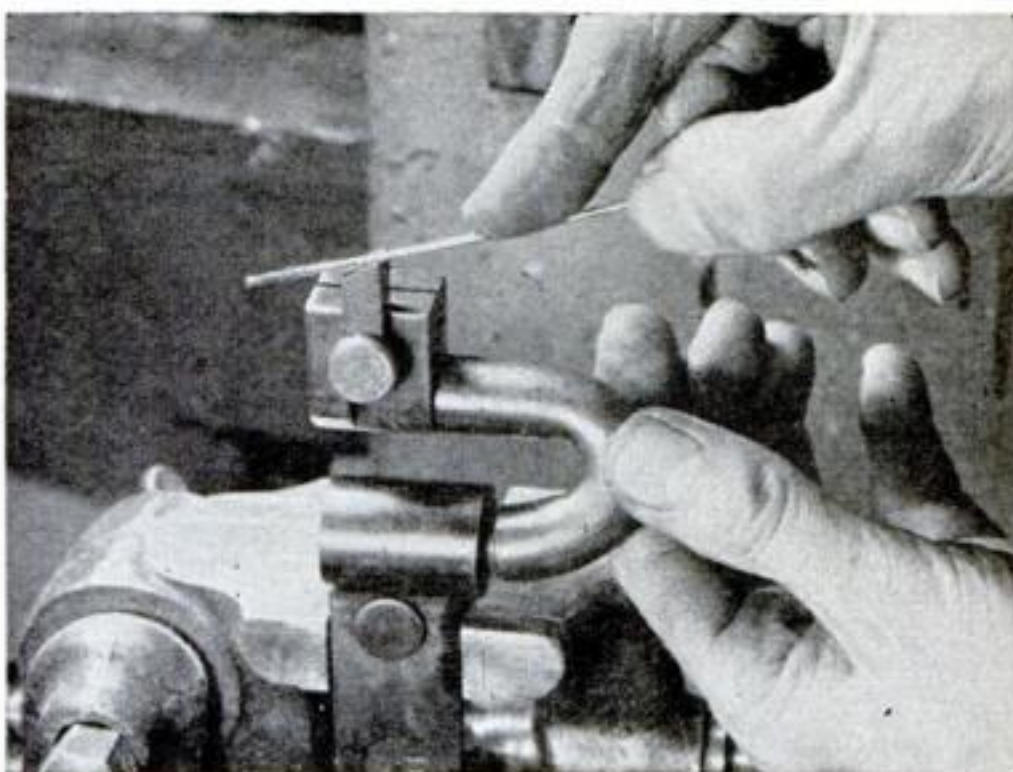
may of course be varied to suit the user, but $\frac{11}{16}$ " holes clear $\frac{5}{8}$ " bolts on machine tables and faceplates while the holes tapped $\frac{5}{16}$ "-18 will take clamps or parallels for mounting work. Use an F drill (.257") as the tap drill for the smaller holes, running it through after threading to provide clearance for $\frac{1}{4}$ " screws. Next, pack-harden the angle irons to a depth of from $\frac{1}{32}$ " to

$\frac{1}{16}$ ", sending them out if necessary to a heat-treatment specialist. Finally, re-heat the irons to a light straw color to relieve stresses, surface-grind the faces 90 deg. to each other, and grind the back edges of the irons to 45 deg. with the faces.—J. A. BLAKER.



POPULAR SCIENCE

RADIUS TOOLS may be dressed to final shape or resharpened by lapping with a piece of wire charged with abrasive grains. The radius of the lap should naturally be the same as that desired in the tool notch, and the lap should be of copper or other soft metal, rather than steel. A rod or tube can be used for producing larger radiuses. For fast cutting, use No. 100 grit, finishing off with a finer grit for the final honing. Mixing the grit with water or oil will help in charging the lap. This wrinkle is particularly handy when a grinding wheel dressed to the desired radius is not warranted for preparing just one radius tool.—W. E. B.

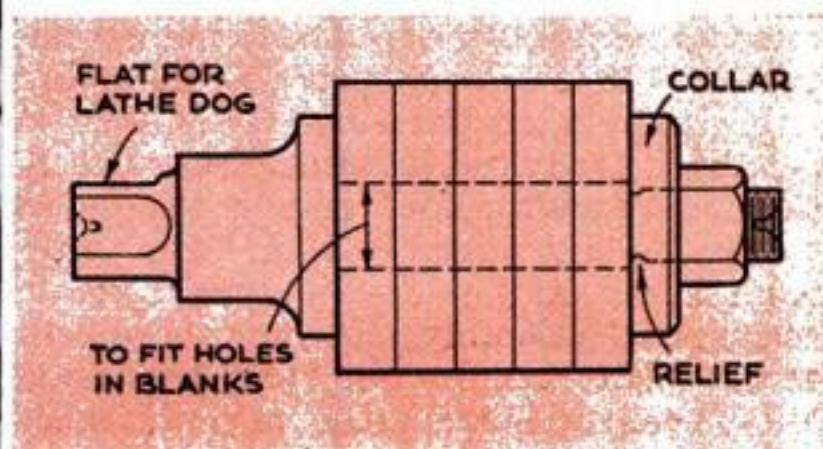
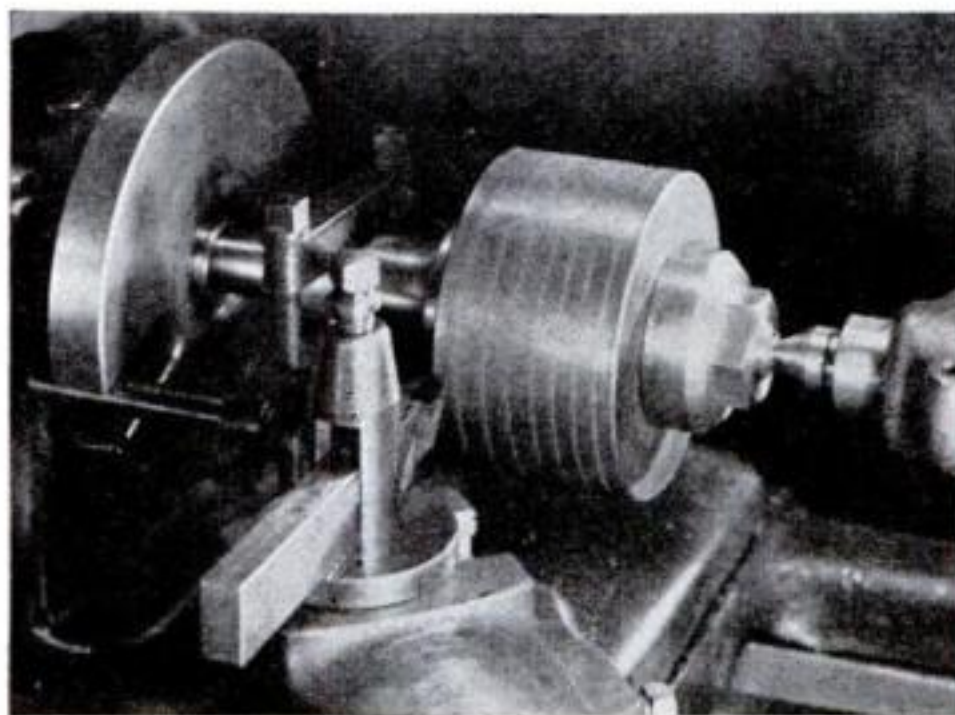
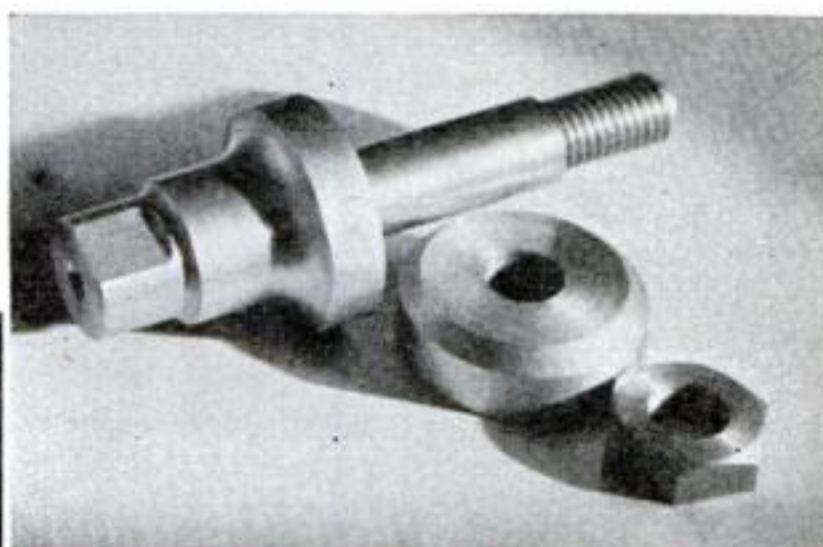


CHATTER, often a chronic complaint with fly-cutter bars, is held to a minimum with the milling-machine tool illustrated at the left. Besides being unusually rigid, the holder is of particular value when no milling cutter is at hand for a special job, since only a few minutes are required to grind a single-point tool. The dimensions should be designed to suit the machine arbor and the cutting tools to be used. For heavy duty the device should be shaped from one piece of steel, but for light service a holder might be made by brazing the sidepiece or pieces to some round stock.—PHILLIP C. KENDALL.

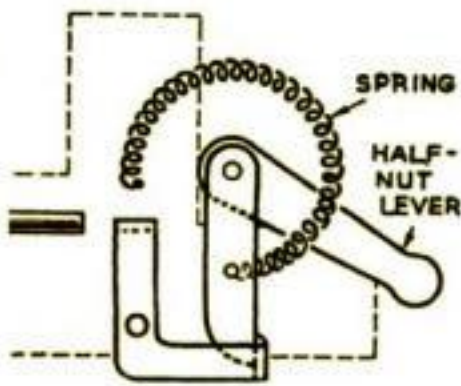
GANG MANDRELS speed up production when a number of gear blanks, disks, or other flat circular parts must be turned to diameter. In making such a mandrel, the shaft is turned to a snug fit in the center holes of the disks, a shoulder is machined on one end, and the opposite end is threaded for

the hex nut that clamps the blanks in place under a heavy collar. Mill or file a flat on the shouldered end so that it can be driven by a lathe dog.—C. W. W.

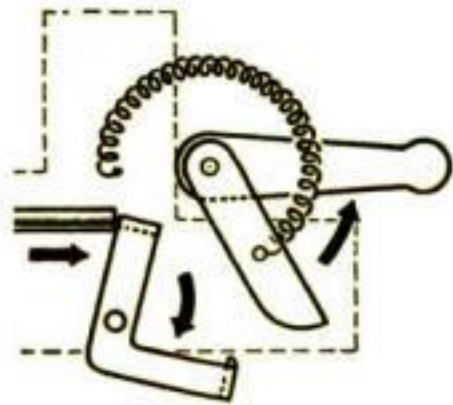
Flat, circular parts such as gear blanks or disks may be speedily turned to a uniform diameter with a gang mandrel. It's especially handy when using thin stock.



AUTOMATIC FEED STOP



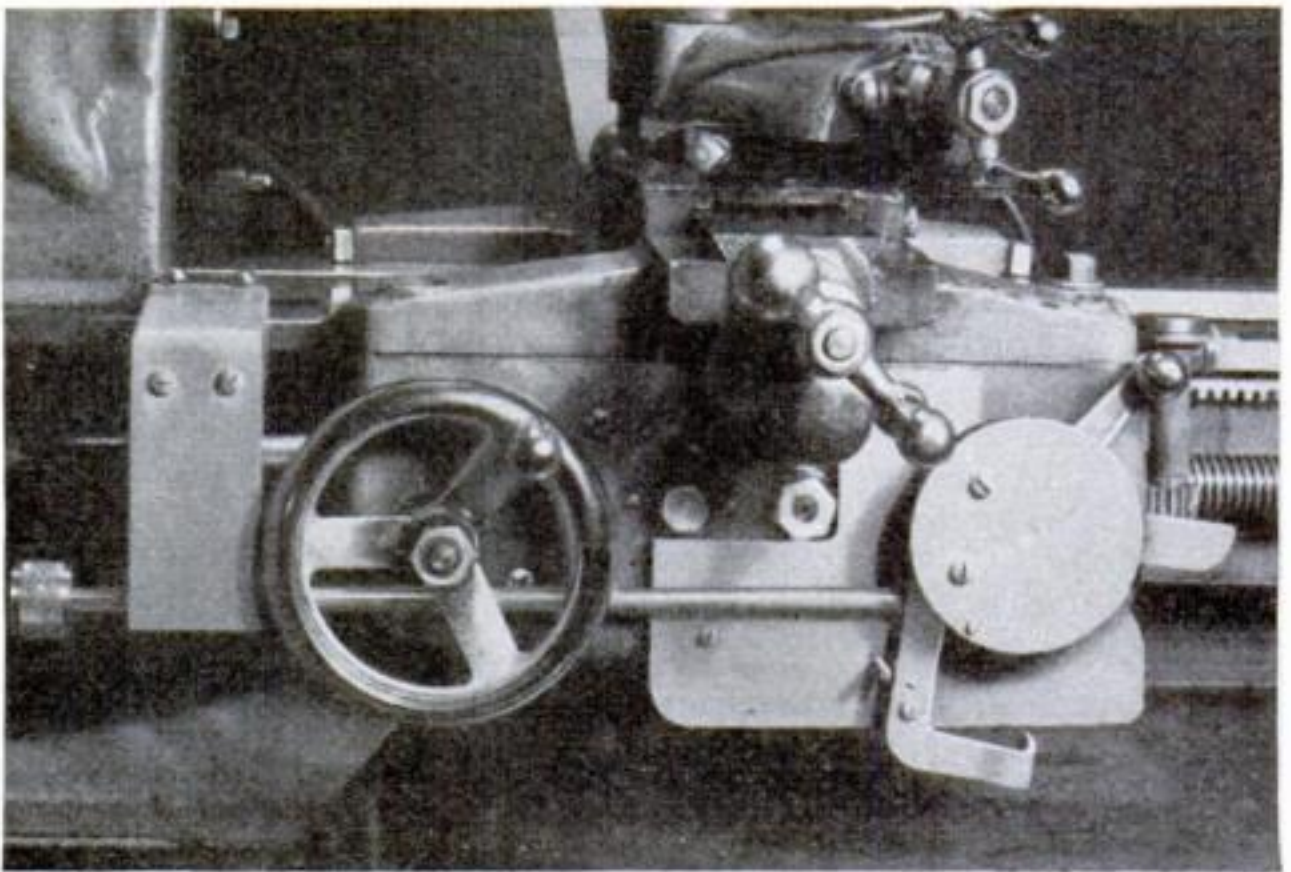
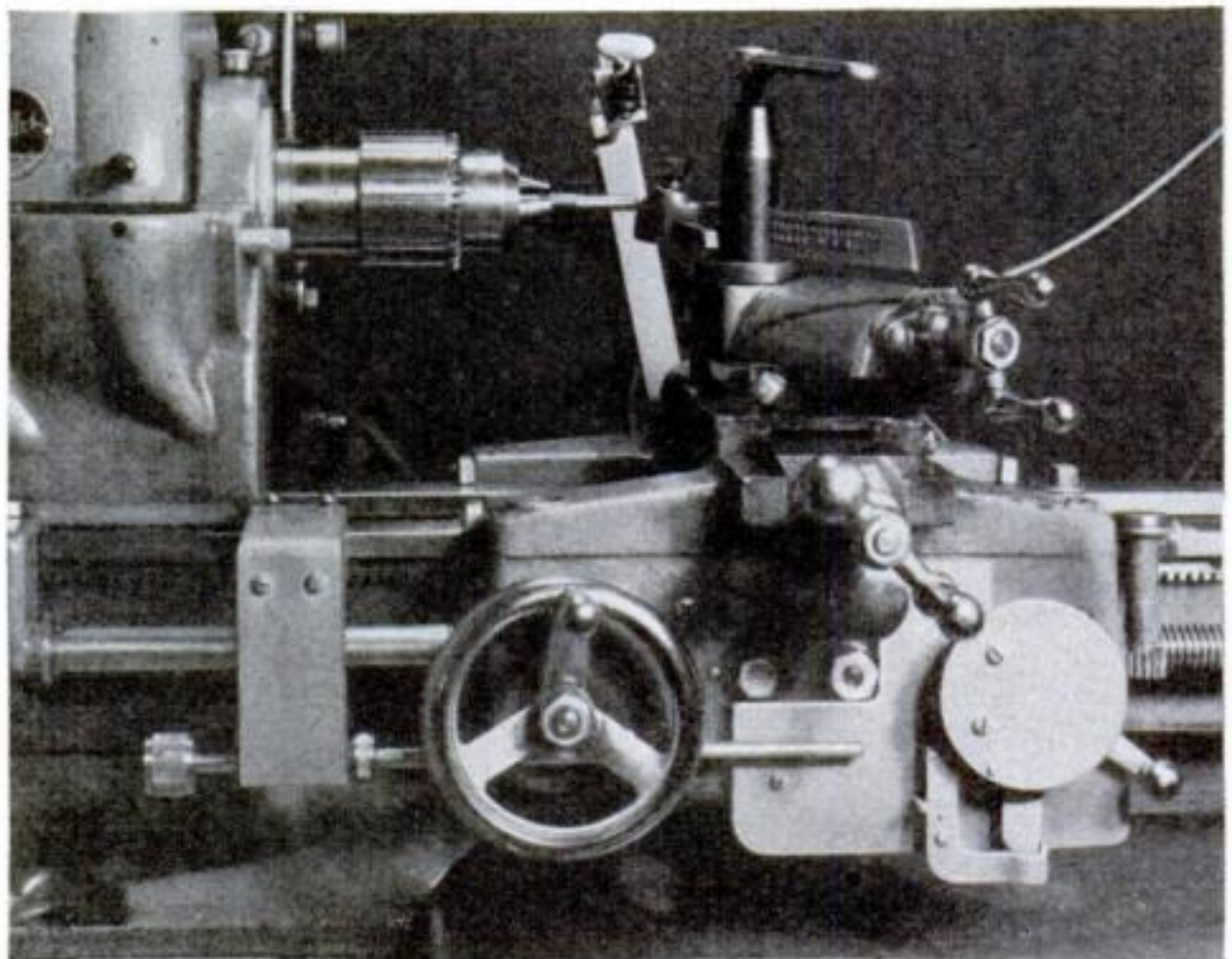
Above and right, a trigger keeps the half-nut lever engaged against the spring tension. When the trigger hits the stop rod as below, the spring snaps the lever up, disengaging the feed.



MOST lathe operators, whether they are in commercial or basement shops, take particular care to see that the power feed is disengaged in time to keep it from driving the carriage into the headstock. That one time in a million, however, when attention is diverted for too long or at the wrong moment may mean a costly breakdown of irreplaceable equipment.

To guard against this, many of the larger lathes are provided with an automatic feed stop. The attachment is not standard equipment for small lathes of the home workshop type, but it is not expensive to make, nor is it a complicated device.

Such a feed stop, both accurate and fool-proof, is shown above and in the drawing on the facing page. It was made entirely from scrap materials, and one piece—the release-rod assembly, on which there is little strain—can even be cut from hardwood if a sufficiently large piece of mild steel is not available.



Besides providing a safety factor to prevent damage to your machinery, it will be found exceptionally useful where precision is required, as in turning to a shoulder on duplicate parts or for internal threading, where the feed must stop at exactly the same place at the end of each cut. The trip can be set to halt the longitudinal feed at any desired point within a tolerance of .001".

In use, the stop disengages the feed by moving the half-nut lever through a spring action. Three screws hold the assembly to the apron, and one screw and a lock pin attach it to the half-nut lever. It can be removed in a few seconds, but the device is so

FOR YOUR LATHE

compact that this will seldom be necessary.

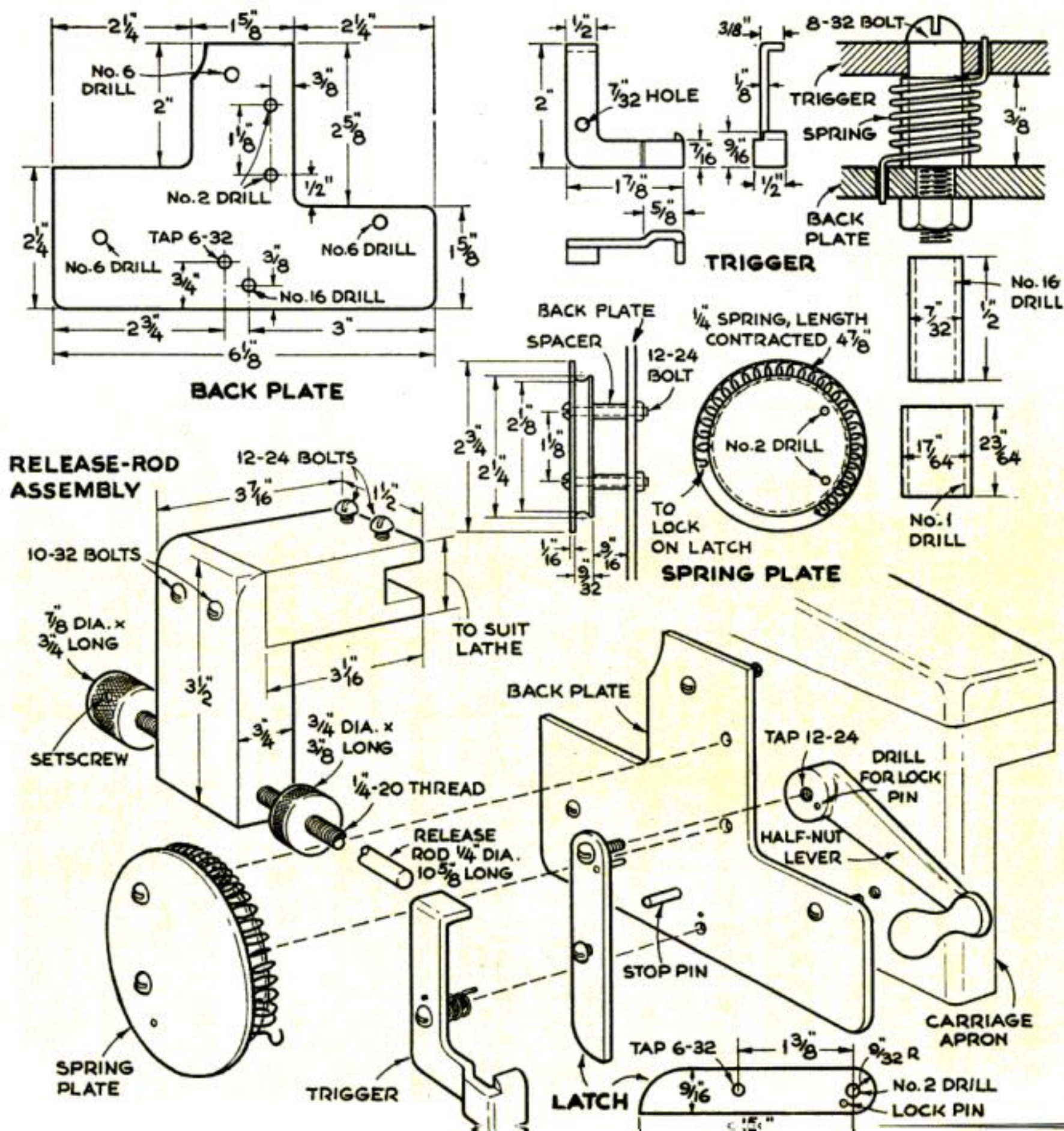
The stop shown was made for use on a 10" lathe on which the half-nut lever disengaged the feed upon being raised. On a lathe where the lever is thrown down to disengage the feed, the spring action will, of course, have to be redesigned to suit. Smooth operation depends upon accurate placement of all parts, so it will be wise to make a working model of wood first in this case and from this to make the final unit. Attention should be paid to the back plate, which must be shaped so as not to cover or interfere with adjustments on the carriage apron.

Care must also be taken with the spring tension on the trigger release. This should be just sufficient to carry the latch and attached half-nut lever to the stop position, in which the spring should be under only slight tension. Part of a tightly wound $\frac{1}{4}$ "

spring of the type that can be purchased at a hardware store will have sufficient tension when extended to move the lever without undue snap.

The best angle between the latch and half-nut lever (55 deg. for the unit shown) is determined by attaching the latch loosely to the lever, engaging the half nut, and then moving the latch down until it is held by the trigger. While it is in this position, a small lock-pin hole is drilled through it into the lever hub.

Care must be taken to see that the release rod hits the trigger squarely and also that it does not interfere with the carriage hand-wheel. The screw end of the release rod is cut with a $\frac{1}{4}$ "-20 thread, as shown, or a $\frac{3}{16}$ "-40 thread may be cut instead so the collar may be calibrated in 25 divisions of .001" each.—WALTER T. WARDE.





EMBOSSING METAL WITH HOMEMADE DIES

Designs that will give distinction to your projects can be hammered on metal plaques and inlaid. Dies for initial sets and the jewel-box inlay above are shown at right.

By **ERVIN WALTERS**

BY CARVING dies from pressed composition paneling or similar material, the home craftsman can emboss sheet-metal plaques and jewelry, fittings for model ships, name plates, and countless other decorative items. You need only a few ordinary tools, and the procedure can be mastered in a few minutes.

First, make the die by carving the design by hand or by machine in hard pressed composition board or similar paneling $\frac{1}{4}$ " to $\frac{3}{8}$ " thick. Second, place a piece of annealed sheet copper, brass, aluminum, or other ductile metal over the design and clamp it to the die with at least two C-clamps. Third, lay one or more sheets of rubber over the back of the metal. Pieces cut from inner-tube patching material or from an old inner tube are ideal for the purpose, or, if you have no such rubber, you might try felt or something similar. Fourth, strike the rubber with a heavy hammer while the die rests on an anvil or other solid support. Continue hammering the rubber until the metal is forced well down into all parts of the design. In some cases you may find it desirable to place a steel block on the rubber and hammer that. A number of duplicates of the article can be made in a matter of minutes. It is surprising how long the die will stand up.

With a moderately heavy hammer, 16-oz. sheet copper (0.022" thick) can be formed easily. Sheet brass 0.010" thick is good for box plaques and similar items. Soft alumi-



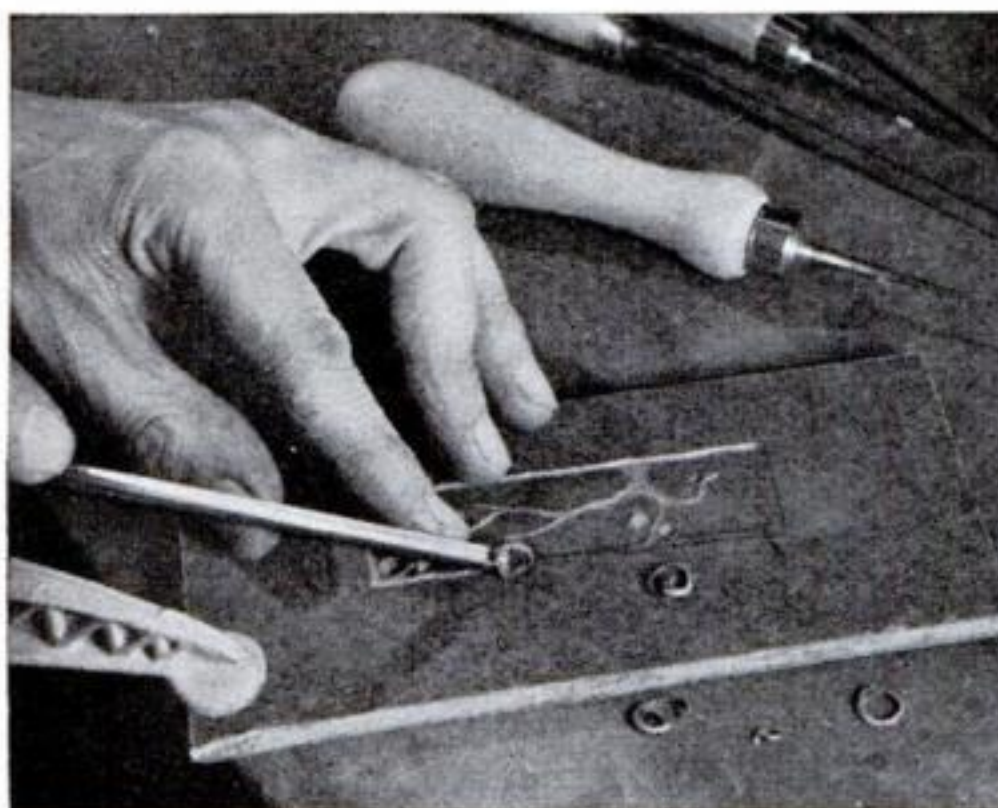
num 0.025" or more thick can be embossed. Sheet pewter and lead are easy metals to work. Silver is more difficult.

If, upon removing the metal and examining it, you discover that some parts of the design are not clear-cut enough, you need only to replace the work on the die and hammer it some more. By judicious hammering you can exert some control over the way the metal is forced into the depressions of the die. Thus, to produce spherical bumps to suggest apples, as in the design illustrated in the photos above, the quickest way of making the depressions in the die is to form shallow holes with a twist drill. But if the hammering is not overdone, the bumps will be sections of spheres and not pointed cones.

Embossed metal can be worked further with a jeweler's saw, as in producing a cut-out design. To strengthen pieces embossed in thin-gauge metal, tin the back and pour solder or lead into the cavities. It is preferable to polish the metal before doing the embossing, but treatment with a soft, power-driven wire brush will produce a pleasing luster after the job has been completed.

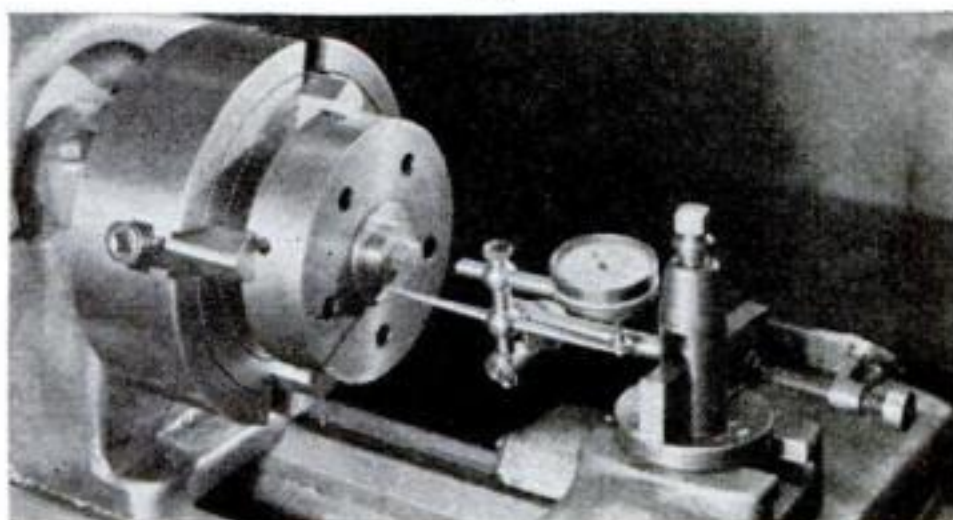
Homemade dies also can be employed to emboss designs in paper and light cardboard. Carve the design somewhat shallower than for metal, because paper does not have much ductility. Shape the bottoms of the depressions exactly as you want the embossing to appear. When the die is very shallow the paper or cardboard can be embossed dry without cracking, but for deeper draws it may be necessary to soften the fibers by dampening the paper. Small-area designs can be embossed at one blow.

Initials cemented to the leather add a smart note to purses. Below, ordinary wood-carving tools are used to cut the die, and a hammer pounds a rubber backing to press sheet metal into the die design.

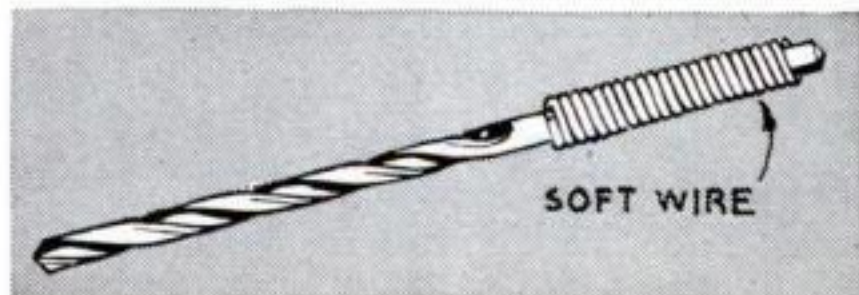


Micrometer Standard Saves Time in Locating Work on Lathe

WHEN the size of the job permits, mechanics can save time by substituting an ordinary 1" micrometer standard for the small toolmaker's buttons usually employed to locate work accurately on a lathe faceplate. This will allow use of a $\frac{1}{4}$ "-20 screw to fasten the standard. Drilling and tapping a hole in the work for this size screw and adjusting the work will be easier than when the usual fine screw is used.—C. W. W.



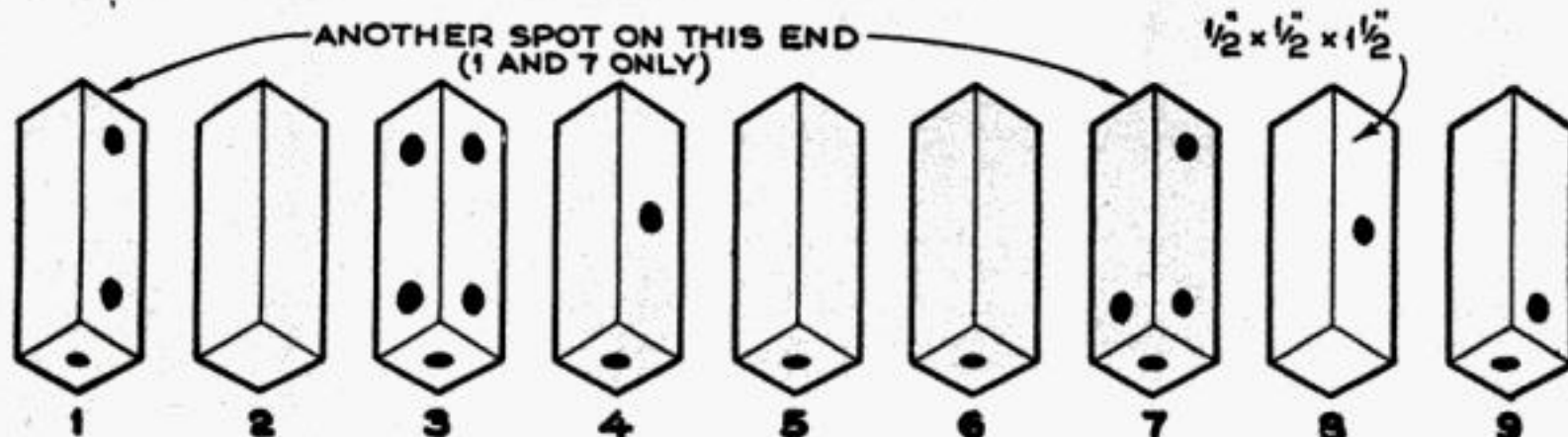
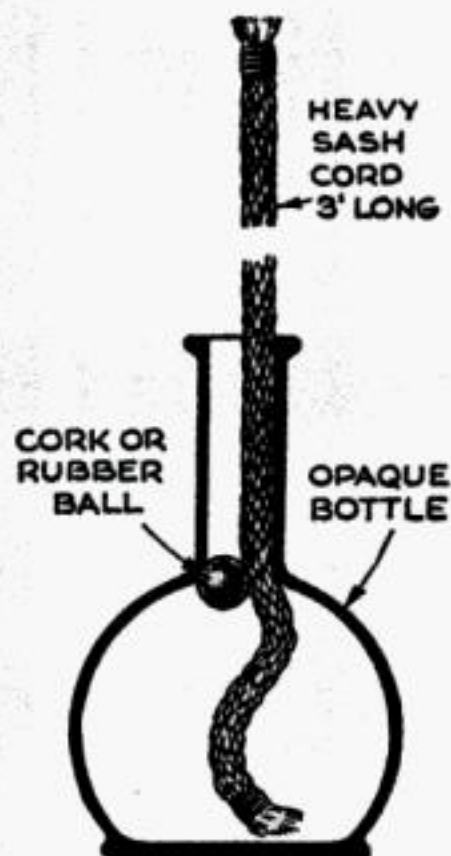
Wire Bushing Holds Small Drills Securely in Large Chucks



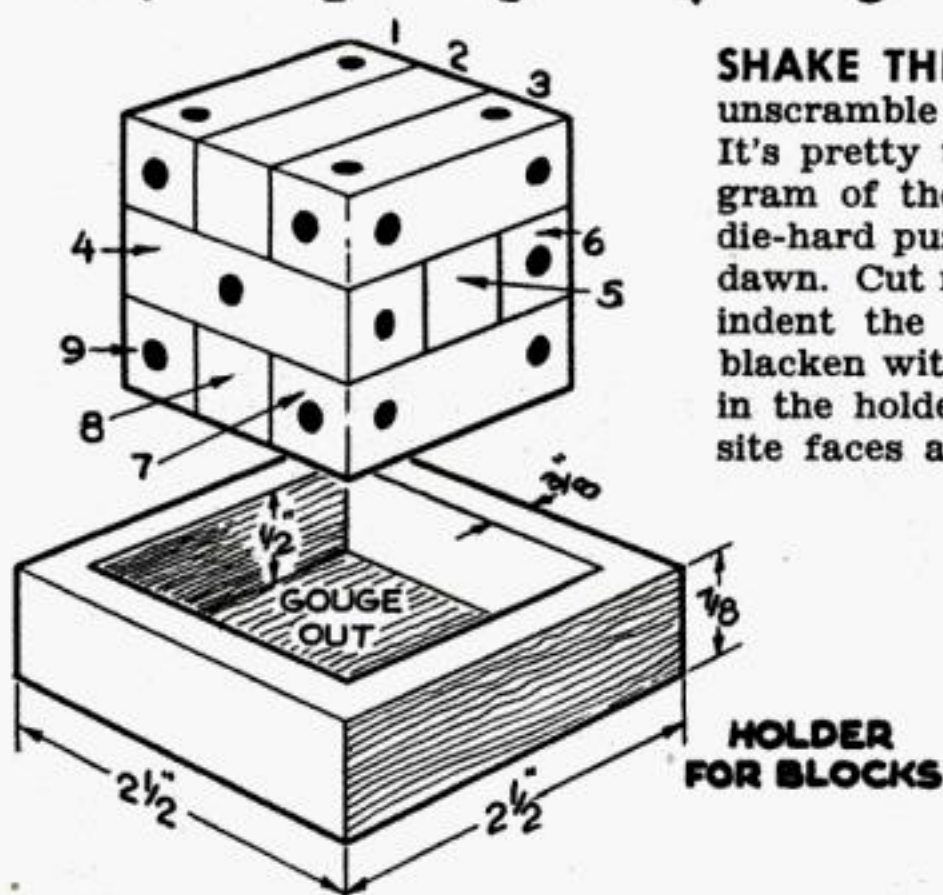
VERY small number drills can be used satisfactorily in a $\frac{1}{16}$ " to $\frac{1}{2}$ " Jacobs chuck if a bushing is formed by winding a small copper wire around the shank, as shown at the left. If the winding is carefully done the drill should run perfectly true.—D. S. GREENLAW.



EVEN WHEN EMPTY, this shapely liqueur bottle can hold a kick for your friends. They will think they're seeing things when the bottle remains mysteriously suspended from a stiff sash cord that fits loosely into its neck. You need only these two items, plus a small cork or rubber ball. Pass out the bottle and rope for inspection while keeping the ball concealed in your palm. When the material is returned, deftly insert the ball into the bottle; then put one end of the cord into the upright flask, invert, and tug lightly to wedge the ball into the neck. Press down to release the rope—G. B.



SHAKE THESE BONES, and then see who can unscramble them into one correctly marked die. It's pretty tough, so you'd better keep the diagram of the solution handy for the comfort of die-hard puzzlers who have to get to bed before dawn. Cut nine blocks, each $\frac{1}{2}$ " by $\frac{1}{2}$ " by $1\frac{1}{2}$ ", indent the proper spots with a nail set, and blacken with a pencil. Stack the blocks upright in the holder for storage. A hint is that opposite faces add up to seven.—G. B.



THE LONG WAY AROUND is the shortest way off in the case of this puzzle. Bend a length of coat-hanger wire into the shape shown. Work the ring to the top of the spiral; then start it down the upright, winding the ball clockwise until it slips through.—GEORGE BARR.

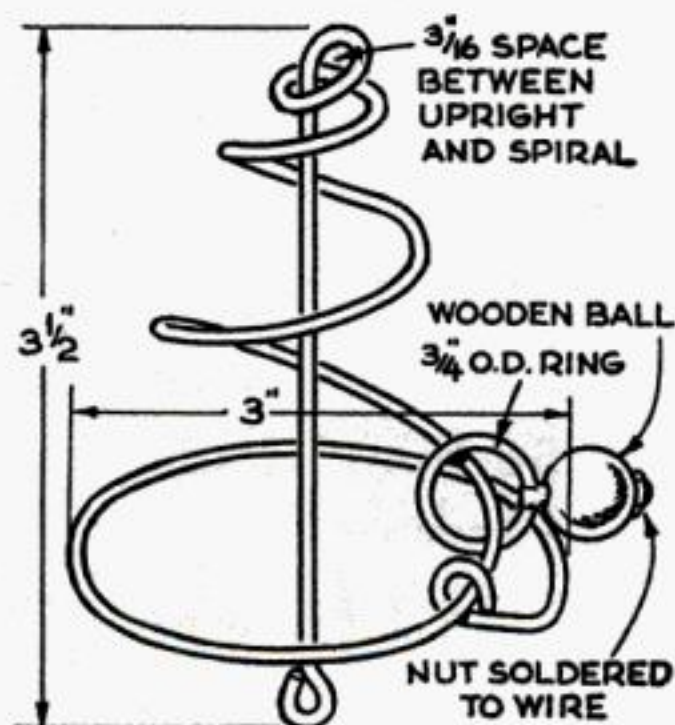




TABLE TRICKS

THERE'S A PROFIT IN LOSS, provided it's someone else's money that disappears through a solid glass. Spread a handkerchief over a coin and pick them both up so that the coin is underneath. Drape the handkerchief completely around a drinking glass held in the other hand. Now drop the coin into the glass with a resounding tinkle. Place the glass on the table, uncover it, and lo! the coin has vanished! Where? Why, into the hand that held the glass, and then, in some inconspicuous fashion, onto your lap or even into your pocket. Before dropping the coin, tilt the glass so that the coin falls against the outside. The sound of clinking metal is the same.

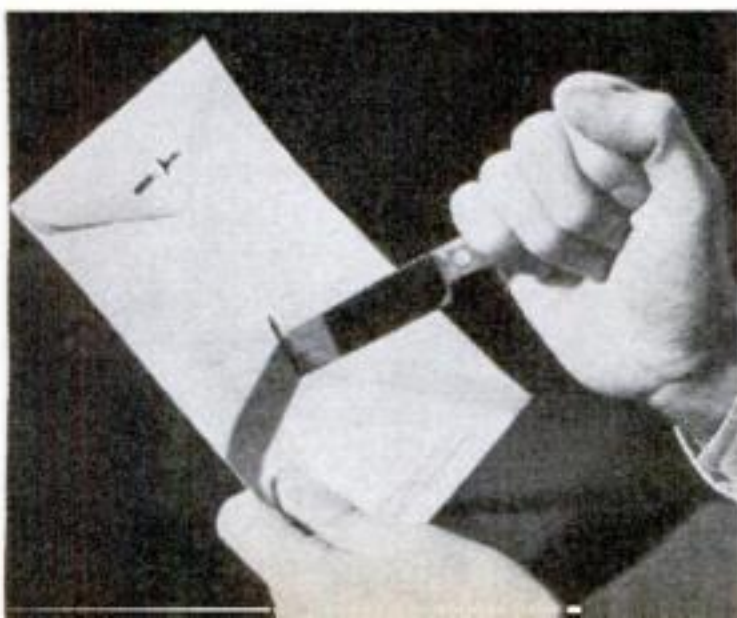
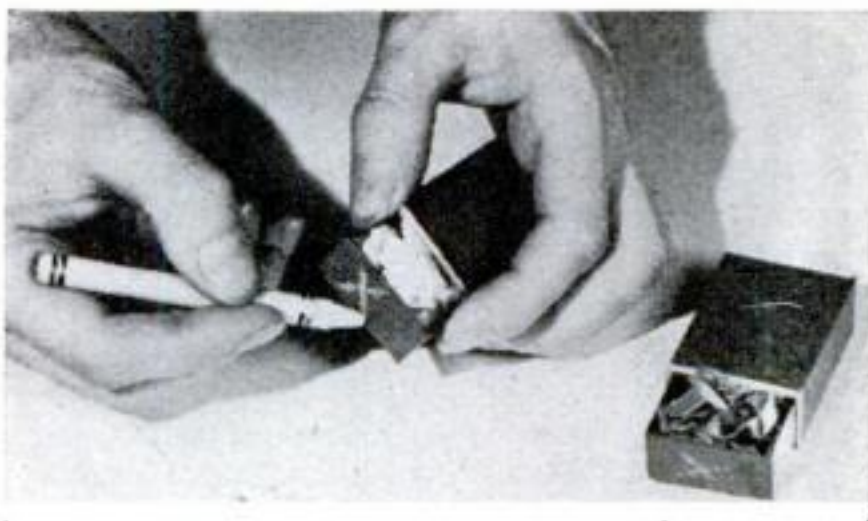
PUTTING YOUR CARDS ON THE TABLE

is only the first step in this guessing game. From there on, everything that happens is definitely on the shady side. After laying out a dozen cards in a line or semicircle, the magician leaves the room and allows his helper to take over. A member of the audience then selects a card. Recalling the magician, but without speaking or signaling in any way, the helper points at random to different cards. When he indicates the right one, the magician calls a halt. There are a number of ways in which the helper can tip off his chief, but one is to prearrange that the helper will point to the correct card im-



mediately after he has pointed to, say, the third one from either end. By varying the key card, you can baffle all spectators.

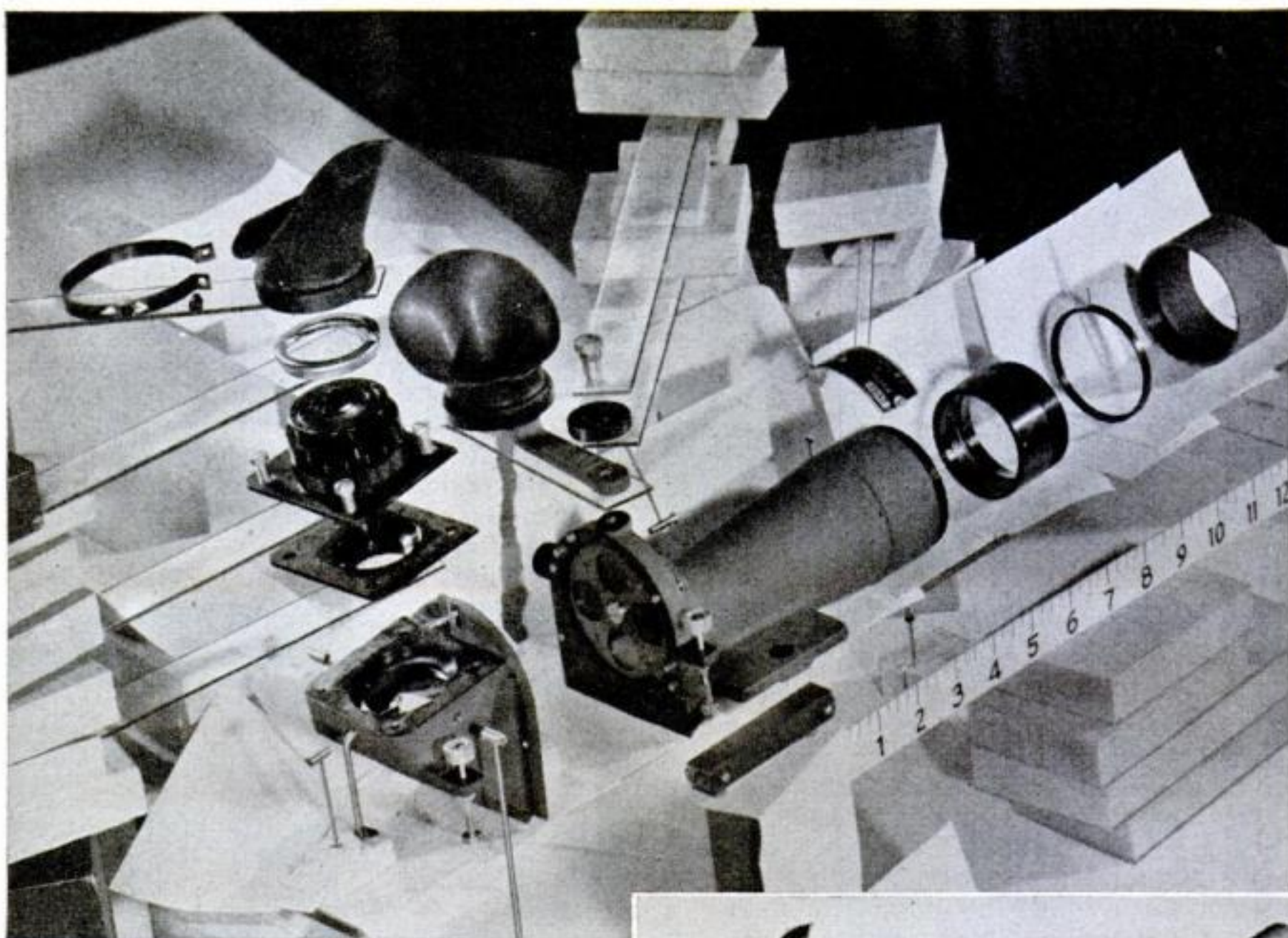
SILK BEING SCARCE, and silk hats scarcer, magicians who once pulled colorful kerchiefs out of their toppers are now reduced to tissue paper and match boxes. Hold two empty boxes with printed sides down, and stuff a bit of distinctively colored tissue into each. Mark the end of each box with an X of contrasting color. Now close the drawers. When the boxes are opened, the papers will have exchanged colors. That is, they will have done so if you have previously applied reversed markings to the concealed ends.



PLUNGING A KNIFE through an envelope without damaging its contents is the home trickster's equivalent of sawing a woman in half. It is done by inserting a sheet of unfolded paper into an envelope of about the same size. Close the envelope and drive a knife completely through it. Then withdraw the knife, open the flap, and pull out the sheet, unfolded and unharmed. Slit the envelope as shown so that the paper will slip out the back when it is inserted.



PULLING A



As the camera sees it, above, a military telescope is a surrealist hodgepodge of parts and their supports. After the background is painted out, right, the result is an "exploded" photo.

EVER wondered how they "explode" a picture?

As you've probably read, exploded or "pull-apart" photographs have done valiant duty in war plants. They've taught intricate assembly jobs to housewives who once thought that a blueprint was a wash dress, or a lock washer a man who scrubbed keyholes. In addition, they've greatly helped the Army and Navy in training personnel to maintain and repair complex weapons. And it's likely that after the war exploded pictures will be important in re-training workers for peacetime tasks.

The photos that have made this name for themselves are, actually, a clever compound of legitimate trickery. In general, photographers artfully lay out the parts of a product in proper alignment, supporting them with putty, rods, wire, and glass plates or strips. After the picture is snapped, the negative is retouched to eliminate the supports, leaving the parts floating in air.

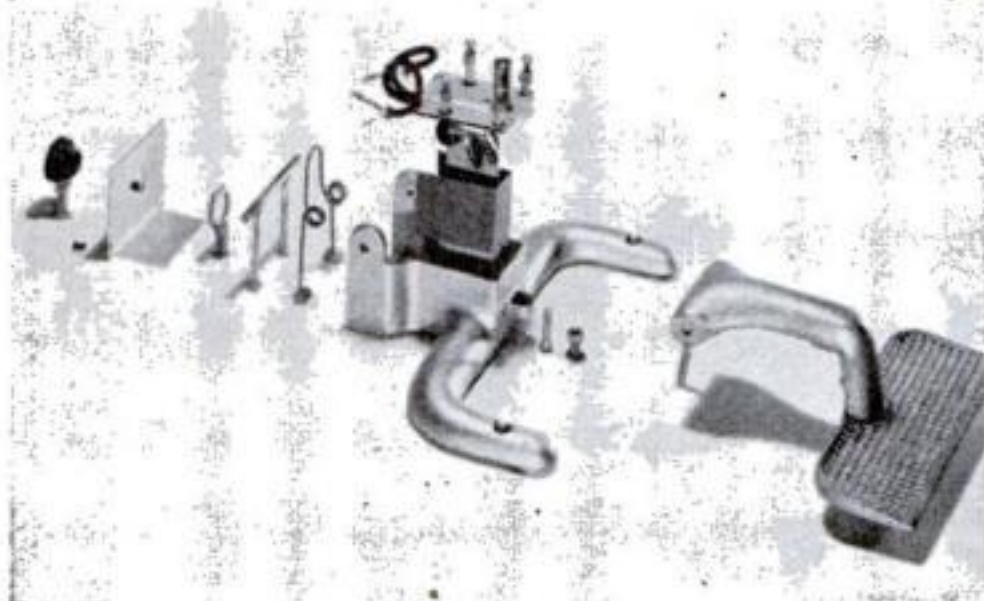
Though simple in principle, exploded



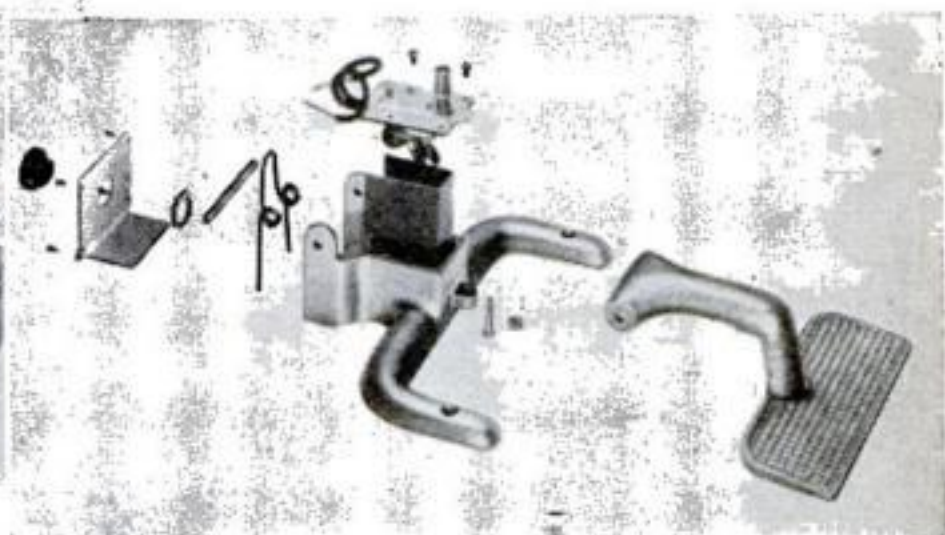
photos offer a challenge to the skill of a photographer. Several different techniques can be employed, depending on the nature of the object to be "exploded," and there are numerous considerations of lighting and background that can make or mar the final picture. Problems of distortion, perspective, and apparent (as opposed to actual) alignment sometimes make the task of obtaining a satisfactory pull-apart far from easy.

The picture above shows a military tracking telescope that, by its nature, demanded an explosion in three dimensions. The horizontal components were arranged along a background of cards, supported where necessary by wire, modeling clay, pieces of weld-

PICTURE APART



Unobtrusive supports of wood and clay hold the parts of a switch in visual alignment along an axis. Right, supports and shadows are removed.



ing rod, and blocks of wood. The parts along the vertical axis were held by rectangular strips of plate glass that were in turn held between blocks of wood. Still other pieces were suspended from wires or perched on small dowels. Then, after the retoucher had eliminated the confusing welter of supports by opaquing the background, and after the key letters and parts list were added, the resulting photo was clearly understandable.

Often it's possible to contrive an explo-

sion in two dimensions rather than three. The foot switch at the top of this page was made by drawing a light pencil line diagonally across a grey cardboard background, and lining up the parts along this axis, supporting them where necessary with putty or dowels. (Actually, the parts were not precisely lined up along the axis, since parts must sometimes be moved away from the line to give the *illusion* of alignment.) The resultant negative, a print of which is reproduced at the left above, was retouched to remove putty, dowels, and shadows.

Other techniques can be used that lessen or eliminate the need for retouching. One consists of aligning the parts on large glass plates mounted in parallel planes. The camera is placed at an angle of 35 deg. with the glass to minimize reflections, and a polarizing screen may be placed over the lens to reduce them still further. With a light-colored, strongly illuminated background, this method, shown schematically in Fig. 1, can give the illusion of objects suspended in mid-air. A modification diagrammed in Fig. 2 calls for arraying the objects on a large sheet of glass which is itself suspended over a ground-glass background lighted from below to kill all shadows.

For amateur photographers who wish to experiment with making their own pull-aparts, a few pointers are suggested by the Eastman Kodak Company, which provided the accompanying photographs. As a rule, pick a method that calls for as little retouching as possible, which means in general the methods shown in Figs. 1 and 2. Use a small lens stop to insure the needed depth of field. Flat lighting is desirable to minimize deceptive shadows, though some side lighting may be required to give form and shape to the objects. Pleasing results can often be obtained with a single photoflood lamp moved about continuously during exposure.

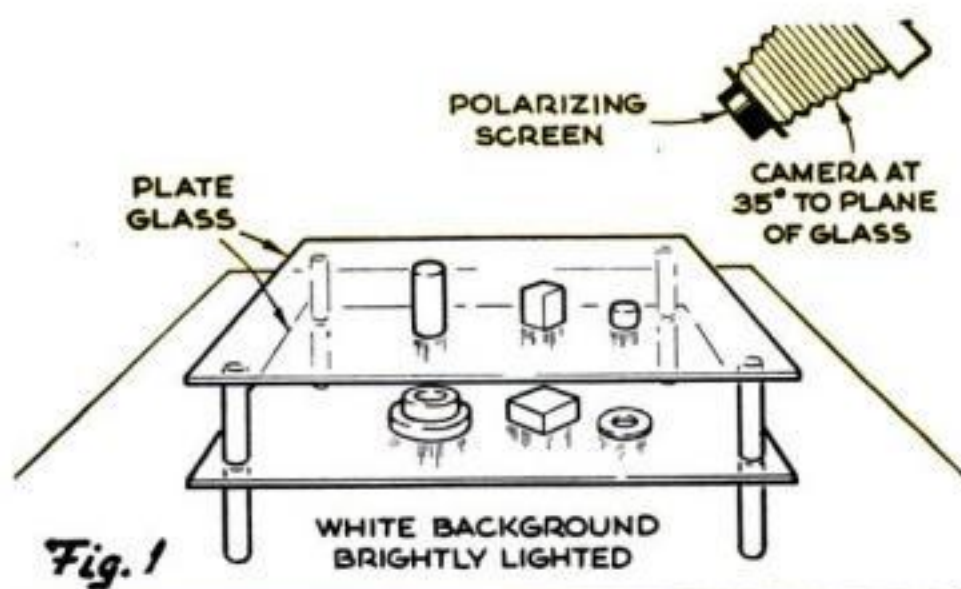


Fig. 1

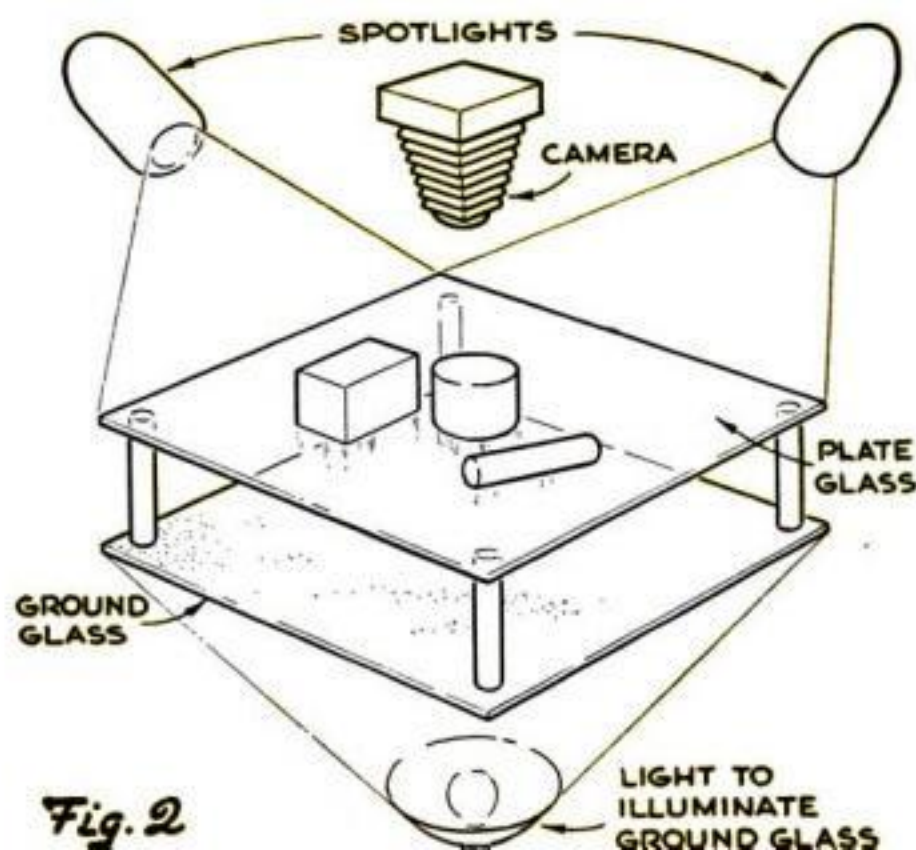


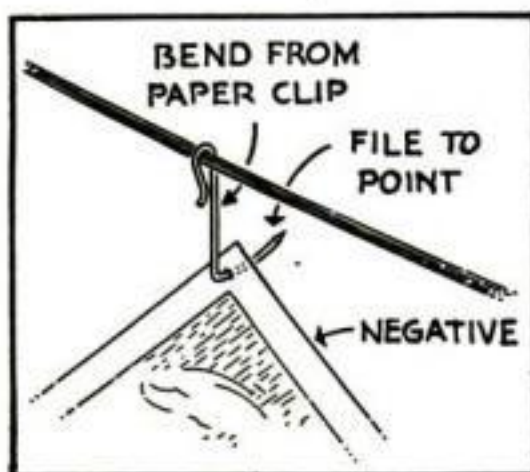
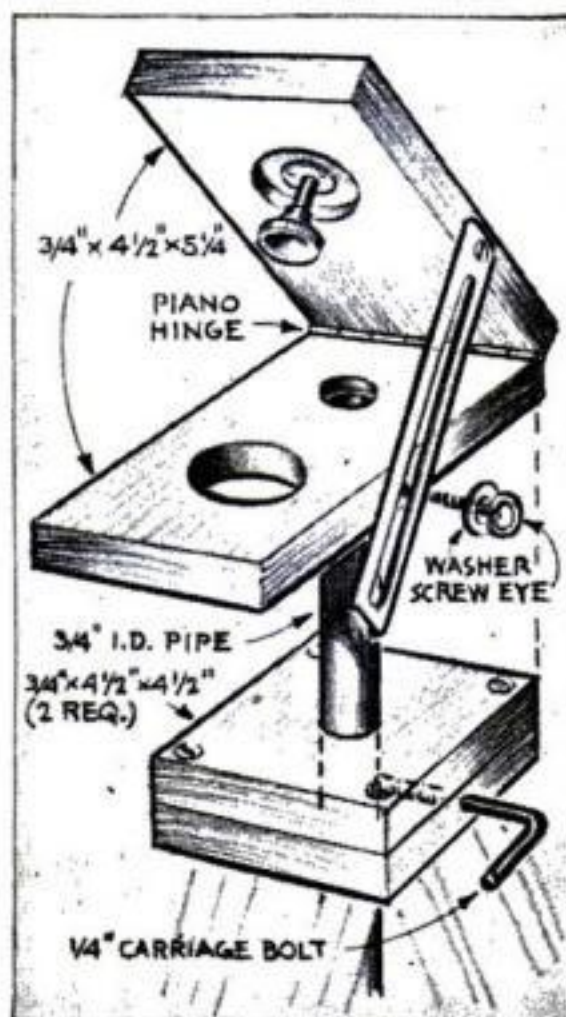
Fig. 2

PHOTO IDEAS



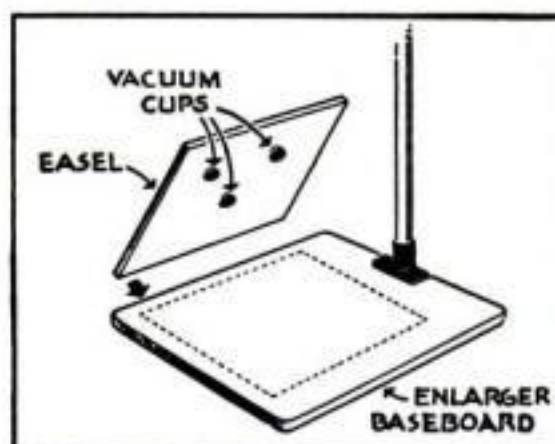
CAMERA STABILITY can be yours with a light crown tripod if it is converted as shown here. Remove the circular head and fasten the three leg pivots to a block made of two pieces of hardwood screwed together with the grain at right angles. In this block bore a hole a tight sliding fit for $\frac{3}{4}$ " pipe, and another hole at right angles to it of such a size that a $\frac{1}{4}$ " carriage bolt may be turned in to cut its own threads.

The tilting head consists of two hardwood boards hinged together, the lower one bored a tight fit for the threaded end of the $\frac{3}{4}$ " pipe. A hole in this piece accommodates the camera mounting screw, and a cabinet bracket locks the board at any angle.—C. W. BERTSCH.



FILM HOOKS made of paper-clip wire take the place of clamps for racking negatives. Bend the clip and hang the films as shown at left.—H. T.

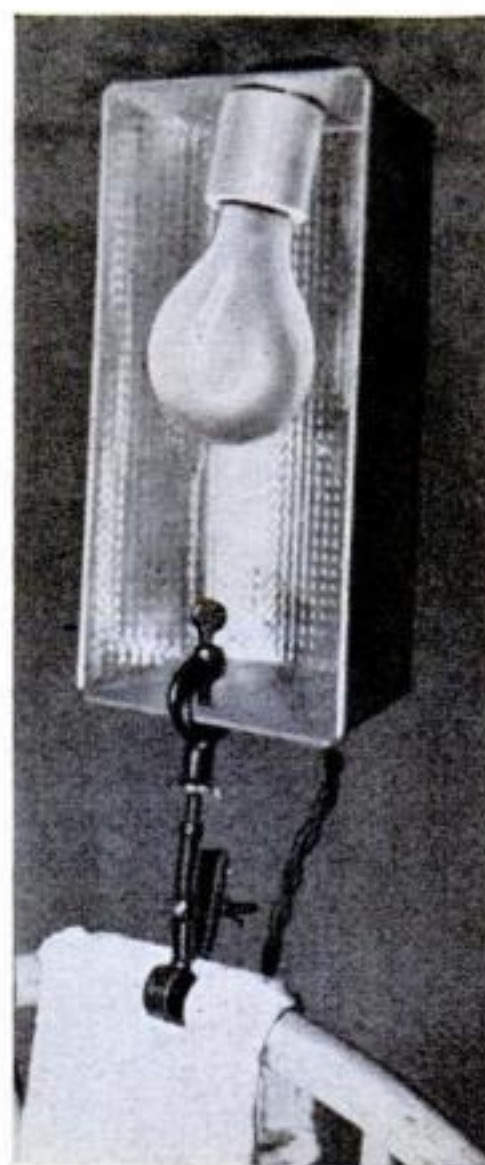
EASEL DRIFT, the cause of many ruined enlargements, can be avoided by means of the vacuum-cup supports pictured at right.—H. A. THOMAS, JR.



BURNED FINGERS are supposed to teach children to stay away from flames, but camera fans keep coming back for more no matter how often they get scorched. You can make photography easier on the hands, however, by adding the inexpensive handles shown below to your photoflood reflectors. The change consists simply of replacing the standard socket with one of the hole-in-top, setscrew variety that will receive a length of threaded $\frac{1}{8}$ " pipe. A file handle bored through serves as a grip. The interchangeability of socket parts may make it necessary to replace only the top of the socket.—LECIL J. SLABACK.



CLAMPS for home-made photoflood reflectors can be improvised from laboratory ring-stand clamps; they are flexible enough to meet any need and fit easily into your traveling case. As seen in the photograph at the right, the thumbscrew at one end of the clamp is tightened around the flange on the reflector while the clamp at the other end is fixed to the back of a chair. The reflector, in this case, consists of an oblong baking pan with a flush socket mounting.—J. SALTER.





Inquisitive young prairie dogs provide an unwitting close-up for the long-range camera focused on them.

Camera Gun Gets Candid Wildlife Photos

In trousers and frowning dignity, a rough-legged hawk poses unknowingly for a photographic study.



FOR those who like to take their ease along with their nature photographs, a long-range camera gun built by J. W. Jackson, of Brush, Colo., should have special appeal. All Jackson has to do is to drive in his car to where wildlife frisks, scurries, or creeps, and without getting out of his seat, as shown in one of the photos on the following page, he can aim, fire away, and drive back home to his darkroom.

The camera is ingeniously constructed, and the results are remarkable close-ups—some of which might be impossible to obtain if the photographer risked frightening his quarry by getting nearer. Jackson uses a 36" focal-length lens, coupled with a range finder. The camera, which takes 3¼" by 4¼" cut film, is fitted with a focal-plane shutter. It is held on one shoulder like a gun and steadied on a tripod or the door of a car. Its shutter release is near the focusing knob, as shown on the next page.



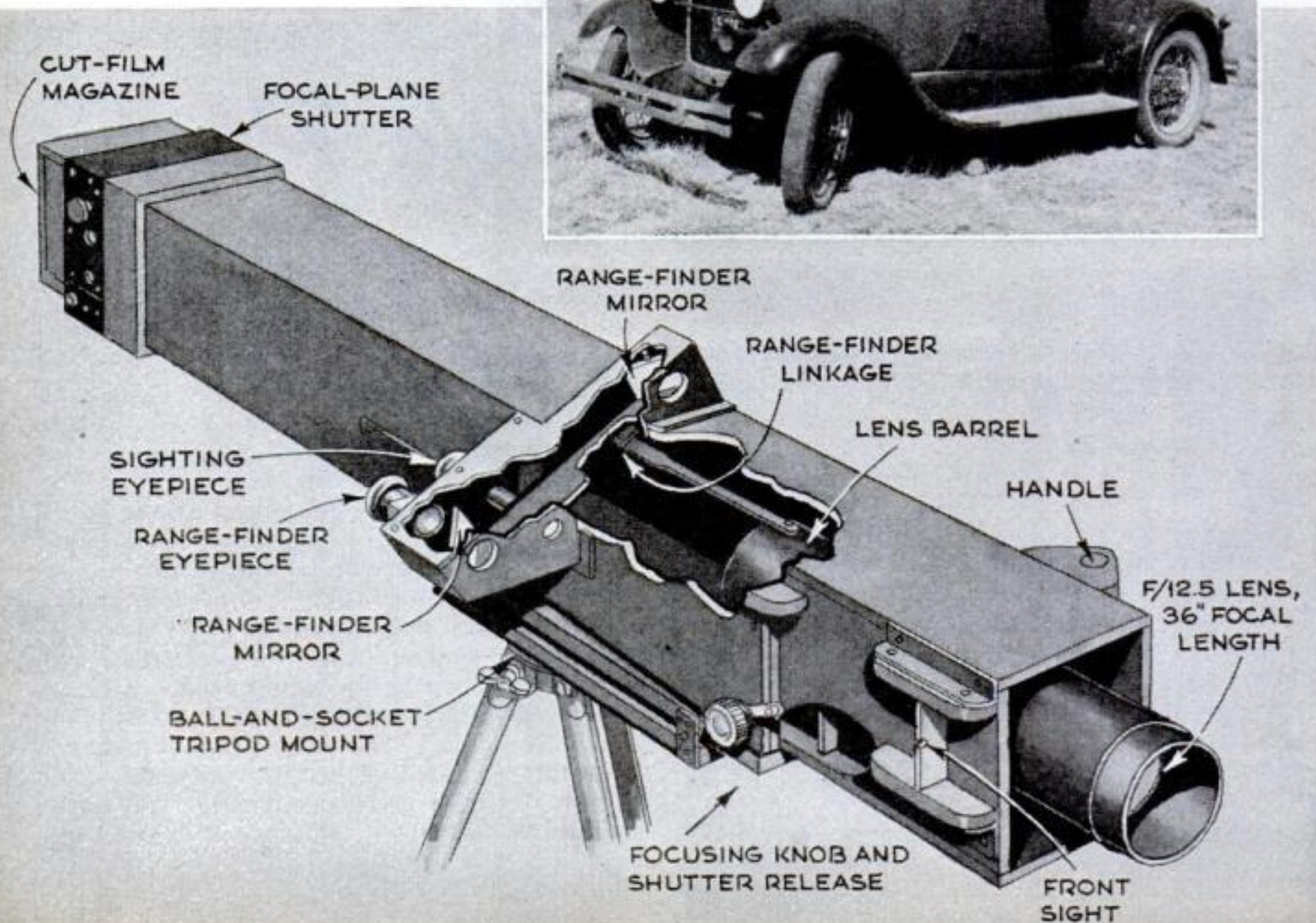


Alert but not yet alarmed, a pronghorn antelope stares curiously in the direction of the camera gun. Shallow depth of focus of the telescope-objective lens necessitates sharp focusing, but blurs the background so the subject stands out well.

Markings show up distinctly on doves perched on a limb in sunlight. Here, too, the camera was at a distance when the "close-up" photo was taken.



HERE IS THE CAMERA that does the job. The operator supports it on one shoulder and a tripod or the door of a car, as at right, his left hand on a handle and his right free to work the focusing knob and the shutter release.





IS IT SAFE TO COME OUT? This close-up of a prairie dog investigating before venturing from its hole would have hardly been possible with ordinary equipment. J. W. Jackson took it with a long-range camera nearly 18' away.

UP ON ITS TOES to sniff what's in the wind, the striped ground squirrel strikes an odd pose unaware of the photographer. This native of the Western plains will be recognized by Eastern readers as a relative of their familiar chipmunk.

SAGEBRUSH AND JACK RABBIT give the photo below Western character. Jackson, who made these pictures, has his studio in Colorado.



Television's Bag of Tricks

CLEVER DODGES BRING WIND AND WEATHER, BATTLE FLEETS, GHOSTS AND OTHER WEIRD EFFECTS TO YOUR LIVING ROOM

By GILBERT SONBERGH

A REGULAR movie-goer can call to mind many clever photographic stunts Hollywood has used. Camera viewpoints zoom in for close-ups over the heads of a crowd. Titles animate and write themselves. One picture "wipes off" another like a growing soap bubble. Slow motion, stop motion, reverse action, and dozens of other special tricks lend spice to the program. If you're a gadget fancier or a student of motion-picture techniques, you know that most of these effects are created by technicians in laboratories equipped with special projection printers, some time between the filming of the action and the time the print is delivered to your theater.

Television isn't like that. Whatever takes place before the electric eye of the tele-camera appears in the living rooms of the audience about one ten-thousandth of a second later. There isn't much time to work on it in between! Because it lacks cutting-room privileges, "live" television technique is distinctly handicapped, as compared with movies. However, there are a few tricks peculiar to telecasting, and many agile minds are at work experimenting with ways to get

around this limitation of instantaneousness.

For example, how would you go about producing animated maps for news telecasts, or animated cartoon characters like Donald Duck? In the movies, thousands of man-hours go into the careful preparation, frame by frame, of such material. On television, there are two distinct ways of animating a map. The first requires a large map on ordinary translucent paper. While the commentator comments, pointers and arrows in brilliant light appear as if by magic at preselected locations. Battle lines surge forth and back. Symbols of tanks, artillery, or planes flash up and move slowly towards their objectives. It's easy if you know how. Assistants behind the map switch on and move about tiny light sources shaped like the objects to be shown. Or they may tear opaque tapes and strips away from previously cut-out masks covering the back of the map to shield it from larger light sources.

The second method of map animation calls for two telecameras. One shows the map, and the other is focused on a black "key sheet" that carries the arrows, symbols, or battle lines. The second camera is flashed off as new animated markers are

SPECIAL EFFECTS. In the cobwebbed corner at the left below, title and credit pages are turned by threads pulled by a concealed operator. The conflagration in the center is created by white powder, compressed air, and bright lights. The rain on the miniature castle, right, is made by sifting down mica particles.



Photos courtesy of the



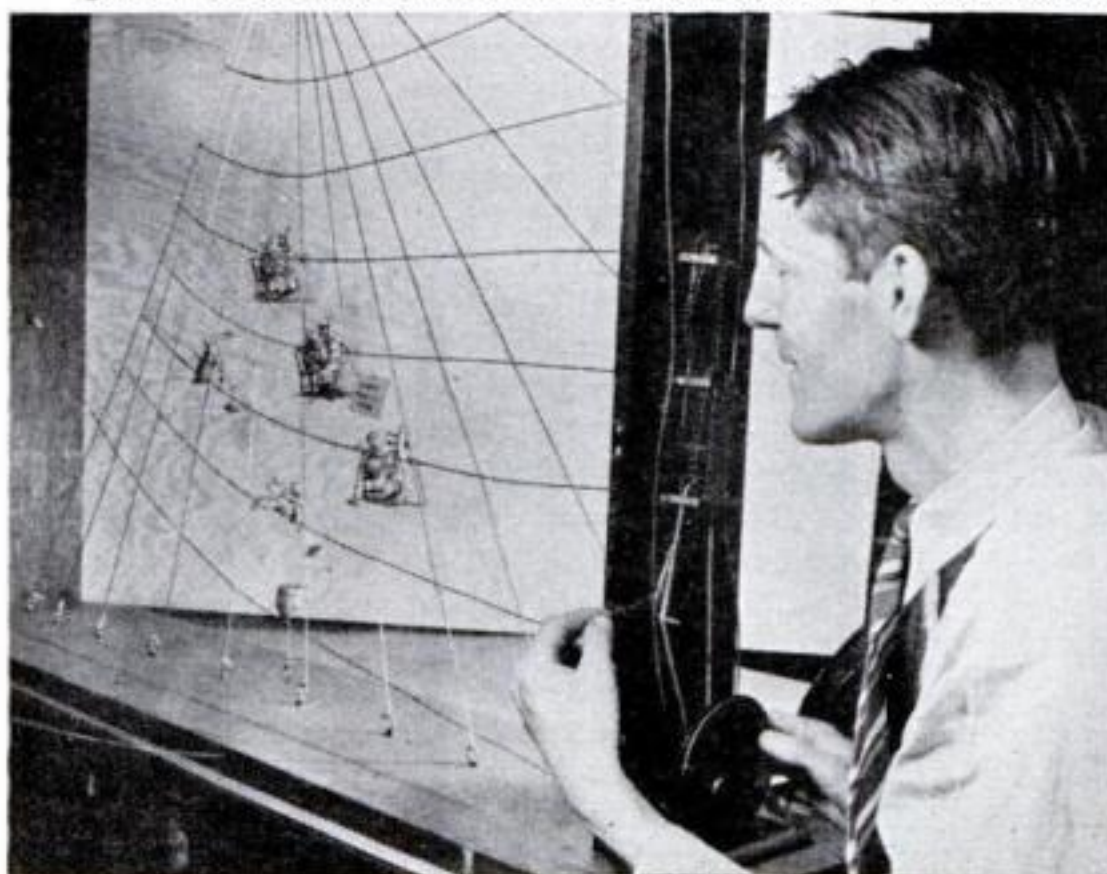
Photo courtesy of Dumont Television

The painted outdoor background in this drama with Judith Allen and Michael Whalen was designed with the peculiarities of the telecamera in mind. The result is a video image that gives the illusion of reality.

added, while the first continues to telecast the map itself. The electrical signals from both cameras are combined before being broadcast, giving the desired double-exposure effect.

Animated cartoon characters are not so

The spidery figures in this web were utilized for humorous titling on one recent production. An arrangement of chains, gears, and flexible shafts moved them before the telecamera.



National Broadcasting Company

simple, but the old profession of puppeteering comes to the rescue. A teleshow may be entirely with puppets, or it may use puppets or hand-type marionettes to turn title pages in a book, or the figures may appear life-size along with flesh-and-blood actors. This last trick is accomplished again by the double-exposure technique. One camera takes a long view of the human characters while another gets a close-up of the puppets. In your living room, they seem to be the same size and to be acting in front of the same camera. Precautions are taken to use proper backgrounds and to limit the relative movements in order to prevent the ghostly effects that would occur if two characters occupied the same space at the same time on your receiver screen.

Sometimes, of course, you want ghosts. "A Christmas Carol," Dickens' famous sob-evoker, was presented by live actors recently. When the ghost of Marley appeared before Ebenezer Scrooge, the audience saw faint outlines of the room right through the body of the returned spirit, and these



TABLETOP HARBORS and other miniature sets have been constructed by television craftsmen to add a punch to special shows. The motor at the left is geared to rotate the beam of a tiny lighthouse...



...while model ships are slowly moved by means of chains on guiding tracks beneath the water level. To the telecamera lens, the model craft riding at anchor resemble the real thing seen from the air.

ghostly lines created a convincing illusion.

Carefully built working models of anything from a battleship to a tarantula have a place in television. Whole sets have been built in miniature to simulate large-scale outdoor events in the confines of the studio. When convenient, television, by means of the motion-picture camera, actually does go outdoors to obtain shots difficult to create inside the studio. A 16 or 35-mm. film scene is shot and then sandwiched into the telecast between the "live" sequences. But here's the trick: the film negative may be used on the telecast! No need to wait for reversal processing or positive prints of outdoor scenes. The negative works just as well, because the video (image) signal can be electrically inverted simply by throwing a switch. Similarly, any actual live scene being telecast can be shown in your living room as a negative instead of a positive when some unusual effect is desired.

Although television has only lately emerged from the experimental stage, numerous special-effects techniques are as well established as the familiar ruses used in radio sound effects. Fog drifts across a scene when a bit of dry ice is allowed to evaporate close to one camera while another camera portrays the action. Snow can be presented similarly by letting finely divided white material settle slowly through a glass tank of water placed before the effects telecamera. A blizzard effect can be achieved by swirling the contents of the tank. Rain is easy. Finely pulverized mica drops through the mesh of a piece of window screen. Any of these effects can be done on a miniature set or, through the two-camera technique, performed before the close-up camera while the main camera picks up the life-size action.

There are two ways to produce fire. Fine white powder can be blown upward out of a miniature building, lighted brilliantly from inside, or actual fire—chemicals or oily

waste—can be ignited on a small scale before the No. 2 camera. It will engulf the studio set and the actors from where you sit comfortably at home, but there's no need to be alarmed. The ten-foot sheets of flame are only three or four inches high in reality, and not nearly as hot as the studio lighting!

Lap dissolves—one scene fading out while another fades in—are a lot of work in film-making. They are made by stopping down the lens of the camera to fade the first scene, rewinding a short length of film, and then opening the lens gradually as the second scene is filmed. Or they can be shot straight and dissolved when a positive is printed. On television, no such legerdemain is necessary. A simple knob like the volume control on your radio may control two variable resistors on the same shaft—one to fade out No. 1 camera and the other to fade in No. 2 camera simultaneously. Another electrical stunt is one whereby a rather complicated box of vacuum tubes in a special hookup creates for television the familiar "wipes" of the cinema. One scene or title is wiped off by an imaginary vertical, horizontal, or specially shaped line, leaving the new scene in its place. Equipment is also being developed for creating montages—pictorial crazy quilts with a number of different scenes going on at the same time.

Here's a puzzler for you: You're watching a psychological thriller on your receiver screen. A man and a girl are struggling for possession of a gun. He overpowers her and shoots. She falls to the floor, dead. The murderer adjusts his tie and steals quietly away. But do you think he avoids television justice? Not by a long shot. The ghost of the dead girl rises from her body, adjusts her ghostly frock, and haunts and taunts the villain everywhere he goes. Meanwhile, we see the authorities come and pick up the lifeless body. How come?

During a rehearsal for the show, a large "still" photograph is made of the girl lying



With the telecamera following the action, the ships get under way as the lighthouse beam sweeps the scene. Any kind of weather, from an Arctic blizzard to a tropical deluge, can be made to order as the script may demand.

Photos courtesy of N B C

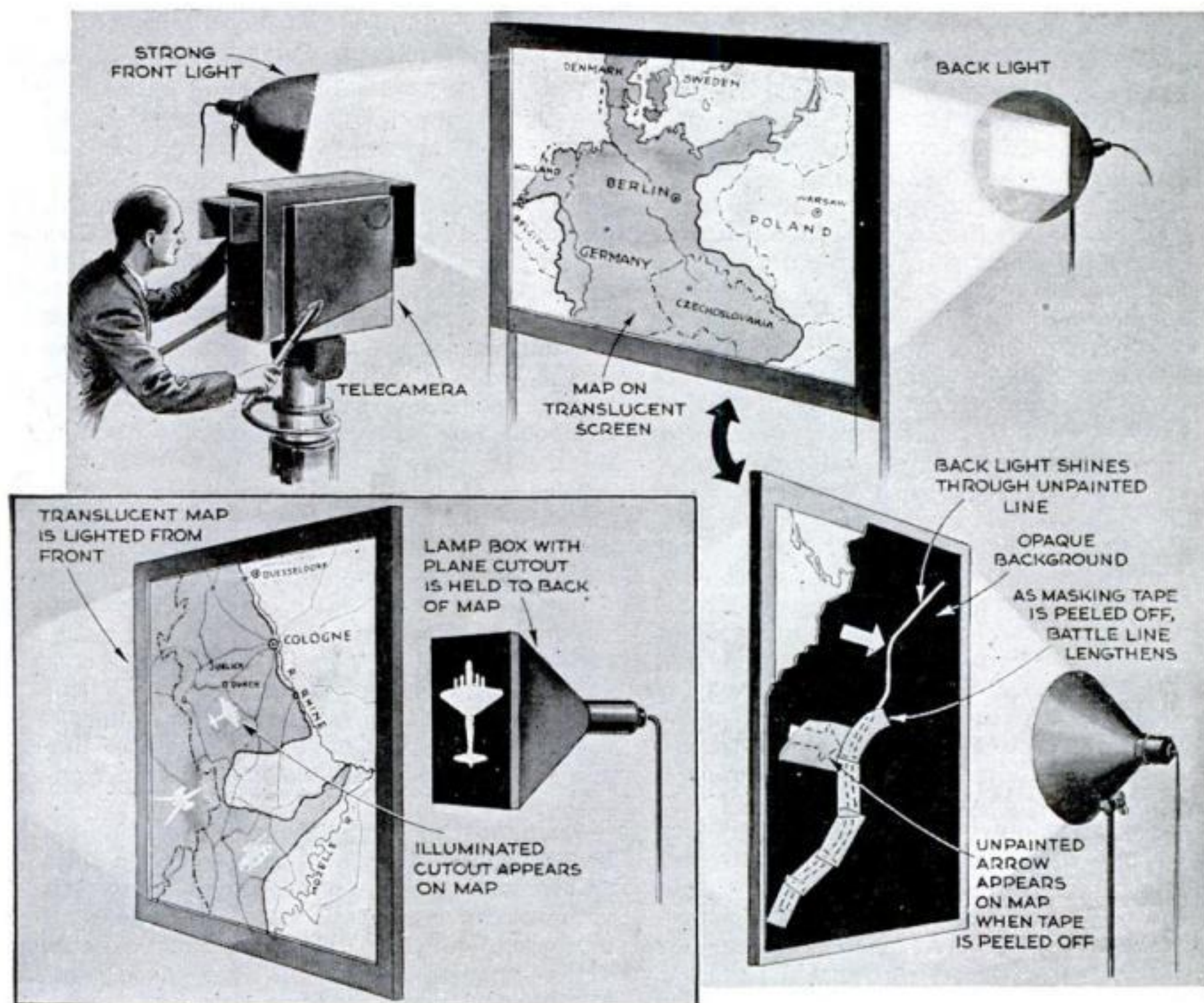
on the floor. When the scene is put on the air, a second telecamera is focused precisely on the photo. After the girl has fallen dead, the picture signals from that second camera are mixed with the signals from the camera following the action. Now the girl can get up to do her haunting, but we still see her motionless form on the floor—from

the photograph. If done skillfully, the illusion is just such a one as must have confronted Macbeth when the ghost of Banquo put in an appearance. To make it effective, the girl's ghost in our teledrama can be fed into the subsequent scenes from a separate camera so the details of the scenes will show through her in approved ghostly fashion.

Bud Gamble, television consultant for Farnsworth Television and Radio Corp., used this still-photo technique in a somewhat different way. A little girl sat at a table and fell asleep. She dreamed she was a canary bird dancing with great glee after escaping from her cage. The girl laid her head

on her arms and, unknown to the television audience, the previously prepared still photo then took her place, while the real girl quickly changed into her canary-bird costume. Gamble introduced another touch in the interim, to ease over the 15 seconds required for the dress-change. The picture had been mounted on a rotary disk, a heavy

SPECIAL TECHNIQUES FOR ANIMATING TELEVISED NEWS MAPS





Photos courtesy Dumont Television



cloud of cigarette smoke was made to drift across it, and the whole scene of the girl asleep at the table began spinning faster and faster, as suitable music built up to a crescendo. At the final instant, the scene stopped to reveal the girl poised in bird-like grace for her dance. Make you dizzy? It was a convincing way to burst into a dream world.

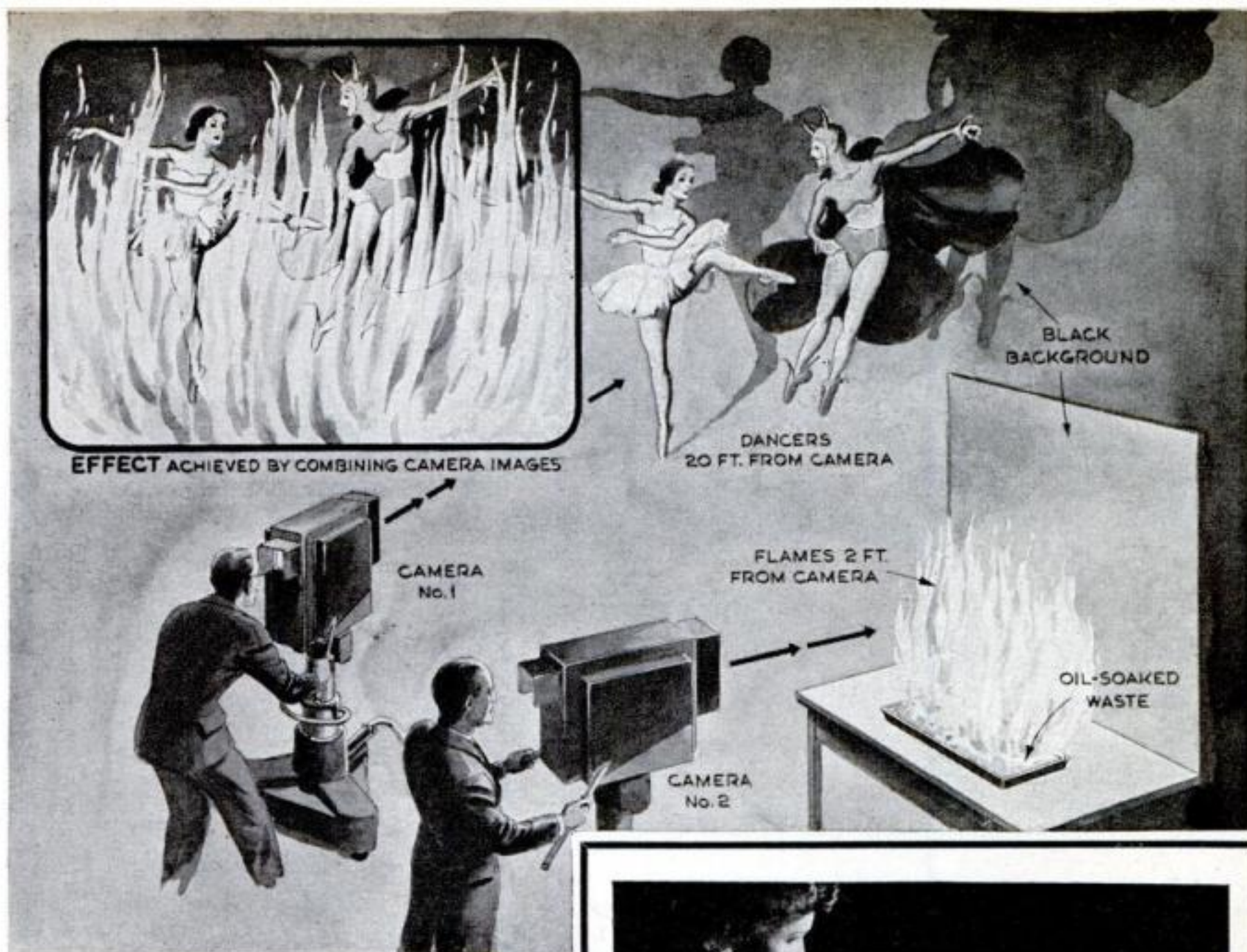
Television already has its own counterpart of Hollywood's "dubbing" technique. Since some singers don't look their best when they strain throat muscles to hit a high C, they're filmed singing easily for looks, then later make the final sound track while watching their own pictures. They don't have to worry about looking pretty and singing well at the same time. Several television shows have had actors, scenery, music, and sound effects which seemed entirely normal to the audience, though not one of the actors was obliged to know his lines in advance. The entire sound track for the show was recorded before the show went on. The studio set was "dead" from the sound standpoint, and the director, standing out of camera range, simply told actors when to start and stop talking! What they said didn't matter, since it wasn't heard outside the studio. Very few watchers detected the occasional slight discrepancy between lips and speech, since few close-ups were used. Prerecorded sound is used in many ways to make for smoother

performances or to permit fewer rehearsals.

Prerecorded video background is coming, too. In the movies, scenes requiring backgrounds of sky, clouds, and landscape are filmed indoors with stock shots of outdoor scenes powerfully projected, from behind, onto a large translucent screen before which the actors move. Experiments with this idea haven't been particularly successful for television because the enormous amount of "front light" required on the actors washes out the background film. Highly sensitive camera tubes promised after the war will make this stunt possible for the telecamera.

Where there's light there's heat. Television actors may have to be able to withstand 120-deg. temperatures working under banks of high-power incandescent lamps. Fluorescents and water-cooled mercury-vapor lights help, but are not entirely satisfactory yet. The poor actors can't even enjoy a dish of ice cream when the script calls for it. Real ice cream wouldn't last in the studio, so they have to pretend to like scoops of vanilla or chocolate mashed potatoes!

Even at this early stage, television has had its share of well-remembered accidents and incidents. Some of them are funny. An announcer overenthusiastically wields a hammer against a sheet of unbreakable glass—and smashes it all over the studio! Easy-to-use mending tape scorches, burns,



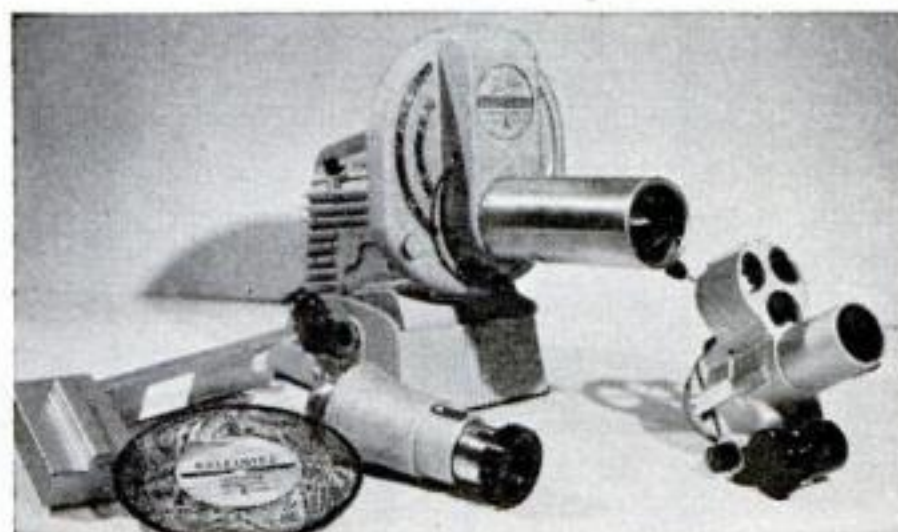
and curls up while being ineptly demonstrated. No-rip pants part neatly in a tug of war. One commercial called for a big dog to turn up his nose in disgust at dog food No. 1 and gobble up dog food No. 2 happily. To insure success, they starved the dog for a day or two so he'd eat No. 2 with the proper gusto. To make sure he'd turn up his nose at dog food No. 1, it was sprinkled with ammonia!

The color response of television cameras is another source of curious mischance. Under certain conditions, a white man in a blue serge suit has been known to televise as a bearded Negro in a white suit! Infrared light penetrates some skins and "brings out" an apparent beard. Ultraviolet light is readily reflected from some types of dark blue material, giving a "white" signal to the television tube. Girls' lips must be made up in a dark purple shade that is out of this world.

But these are details, some of them unimportant. Television is no longer around the corner. It's here now, today, and it's ready to go places on a big scale as soon as materials and manpower are available. Technicians, actors, producers, and advertising agencies are ready, and as you've seen by now, television even has ready its own special bag of tricks!



BEAUTIFUL, constantly changing patterns are projected for the telecamera by the device shown above and below. Developed by Captain Bill Eddy, USN, Ret., of Television Associates, Inc., Chicago, the projection kaleidoscope makes a soothing "bridge" between acts of a show, or as accompaniment to a musical interlude. Replaceable disks permit an infinite variety of patterns.





Meet

HAROLD P. STRAND

GATHERING ideas for articles has been a confirmed habit with Harold P. Strand for many years. Keeping a pocket notebook handy, he jots down ideas as they come up on the job or in

conversation. Later he studies them and develops some into magazine articles. This usually involves designing and building actual electrical devices in the basement workshop of his home in Malden, Mass.

Strand started in the electrical business at 18 and has been at it ever since, even during the first World War when the Signal Corps assigned him to Wentworth Institute, Boston, for special training. At present he is an inspection engineer at Holtzer Cabot Electric Company.

He started magazine work in 1925, designing a radio console cabinet and selling an article on it to *POPULAR SCIENCE*. A bit

later he took a course in photography at M. I. T. to help him illustrate his articles, and for a time he did commercial photography.

In the photo he is finishing an autotransformer that will provide potentials from zero to 230 volts from a 115-volt line.

Electrifying That Antique Sewing Machine

SMALL UNIVERSAL MOTOR AND HOMEMADE CONTROL CONVERT AN OLD TREADLE MODEL INTO A PORTABLE TABLE UNIT

By Harold P. Strand

ELIAS HOWE'S brainchild never had a bigger job to do than it has today. Clothing shortages, together with the duty of contributing garments for war victims, have put sewing high on the homemaker's list of necessary chores. And the sewing machine is so important to the maintenance of the family wardrobe that its care is well worth a few hours of the home mechanic's time.

Maybe the family seamstress now does her best with an old-fashioned foot-pumping model. Or you may have one of those old treadle machines that seems so out-of-date that you have despaired of resurrecting it from its attic tomb. If you have such a machine, or can get hold of one at a neighbor's or in a secondhand shop, you can convert it into an up-to-date electric portable. It will not only make new clothes for your family and repair old ones, but it will be out of the way in a corner of a closet when not in use. All you need is a

little patience, a bit of ingenuity, and a motor of the universal (A.C.-D.C.) type.

If you obtain a machine from a dealer, be sure it is in good condition and that it carries a guarantee covering its working parts. This may not be the case with a machine retrieved from the attic or donated by a neighbor. Remove the machine from its cabinet and clean all the parts thoroughly with carbon tetrachloride or some other grease solvent. If you use one of the inflammable cleaners, do this work out of doors and take precautions against fire.

Check the mechanism for worn and broken parts. Then oil the machine thoroughly and adjust it to work smoothly.

The drawing (Fig. 1) shows a new box-like base just deep enough to house the under part of the machine. You can avoid fitting the top to the metal base of the machine if you use the original wood section, sawing it to the required dimensions for the box. The remainder may be made from new wood or from the old cabinet if

pieces of the right size can be sawed from it. Assemble with screws and glue, sand well, and finish with varnish or shellac.

For the machine shown a motor was taken from an old table-model baby-clothes washer. It is a universal type having a commutator and brushes like a D.C. motor. This is about the only kind that works satisfactorily for great speed variations on A.C. when a resistance or reactor-type control is used. Such a motor is customarily used in electric drills, food mixers, vacuum cleaners, and similar appliances.

It may be difficult, without the aid of shop testing devices, to determine whether the motor at hand will drive a sewing machine without being overloaded. One test that you might try involves use of a wooden pulley $\frac{3}{8}$ " or $\frac{7}{16}$ " in diameter that is a tight drive fit on the shaft. Hold the pulley firmly with your fingers; then apply the full current for a moment. If it takes a firm grip to prevent rotation, this is a rough indication that the motor has sufficient torque.

Figure 2 shows a bracket for the motor and pulley. The latter was made from soft rubber, and is brought to bear against the machine handwheel by means of a coil spring as shown in one photograph. Shape the pulley by holding a half-round file against its face as it turns. If $\frac{1}{8}$ " pipe isn't a drive fit for the shaft, a suitable threaded bushing must be found or turned.

The bracket illustrated will not fit all motors and is shown chiefly to give an idea of how one should be constructed. You will probably find soft steel of the size given satisfactory in most cases. Shape it carefully to go about half way around the body of the motor. A steel strap hinge will serve to make a movable joint with another sec-

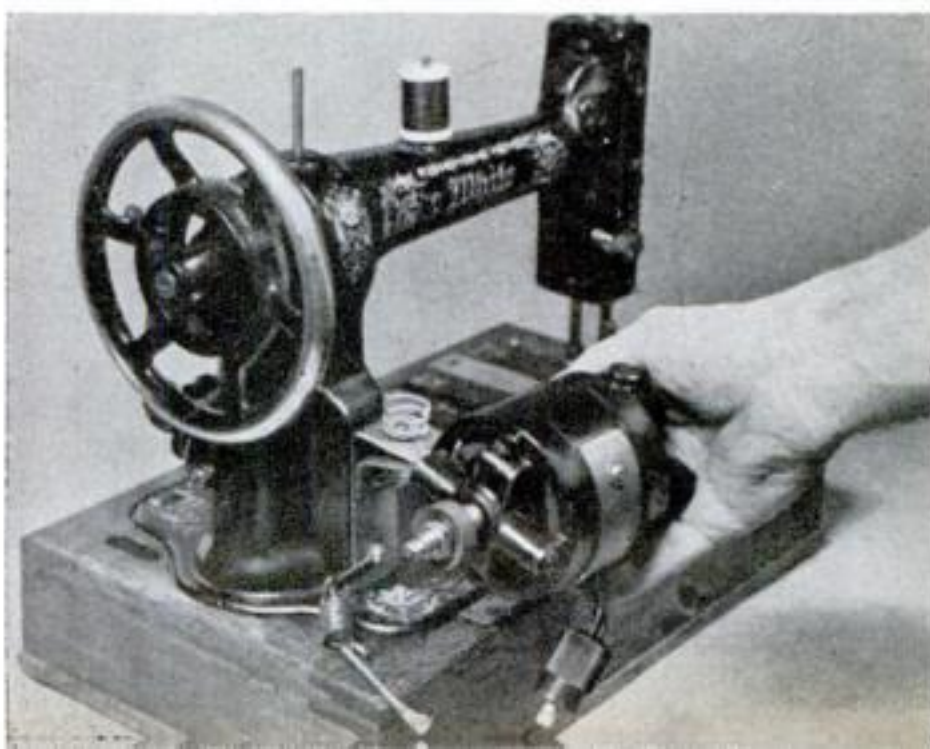
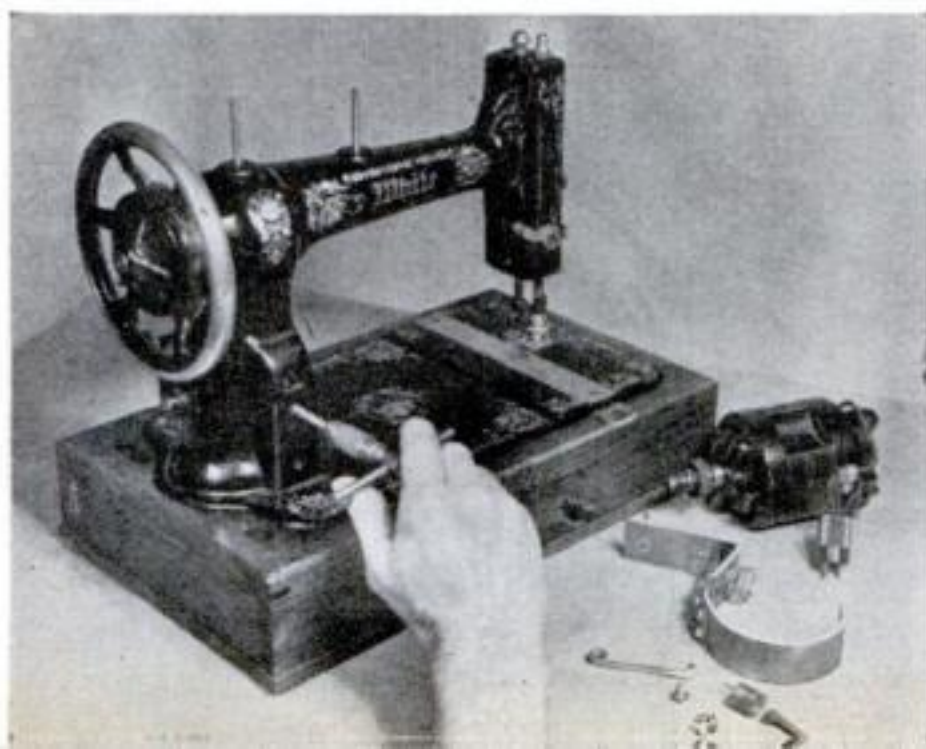
tion that is fastened to the side of the machine standard with two 10-32 machine screws. Holes will have to be drilled and tapped in the standard and also in the body of the motor to take the mounting screws. A coil spring (not the rebound spring in the drawing) and a hook apply the necessary tension to the pulley, as shown in one of the photos. The upper end of the hook

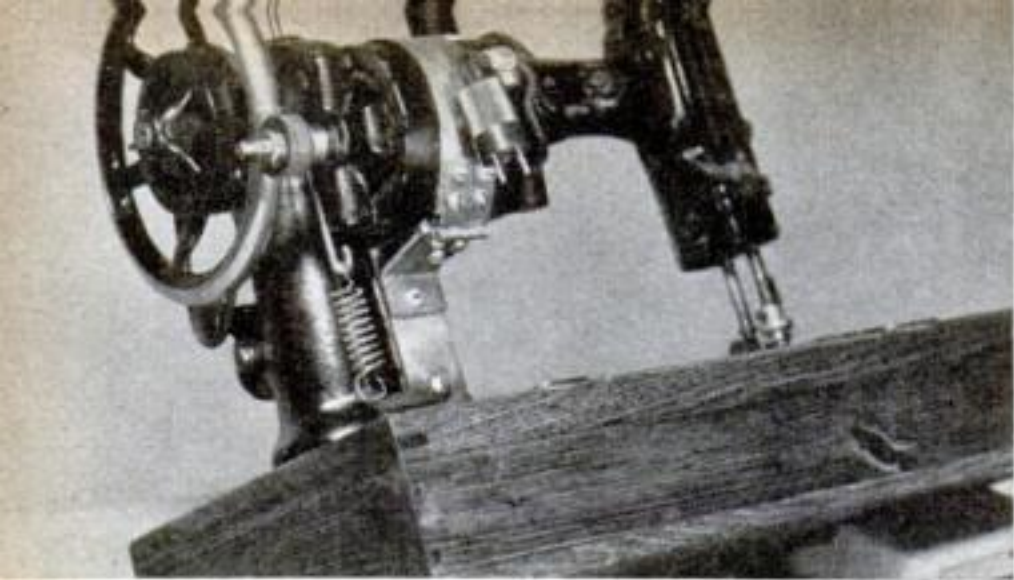


Rescued from the attic, this old sewing machine helps the clothing budget as an efficient electric portable.

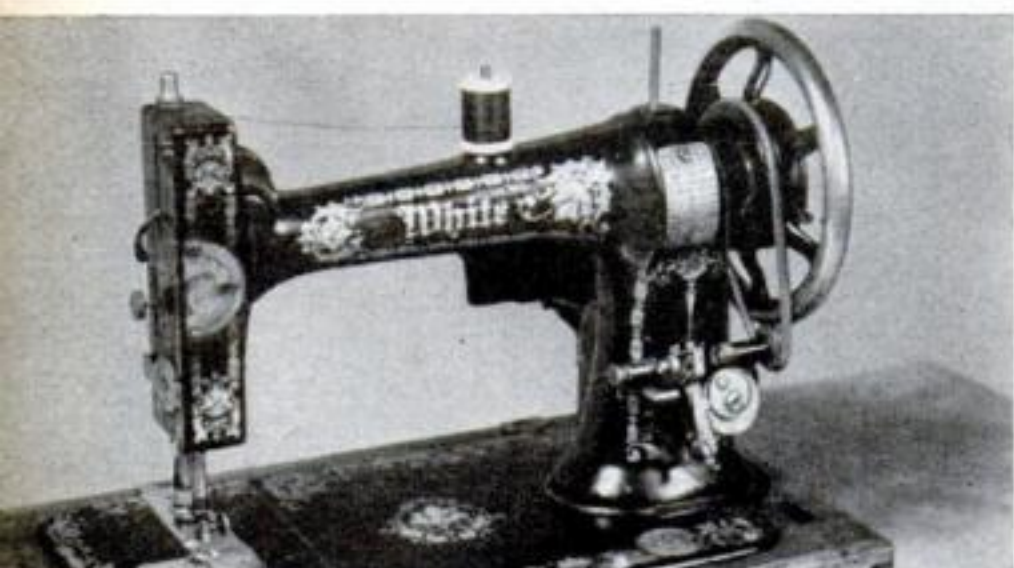
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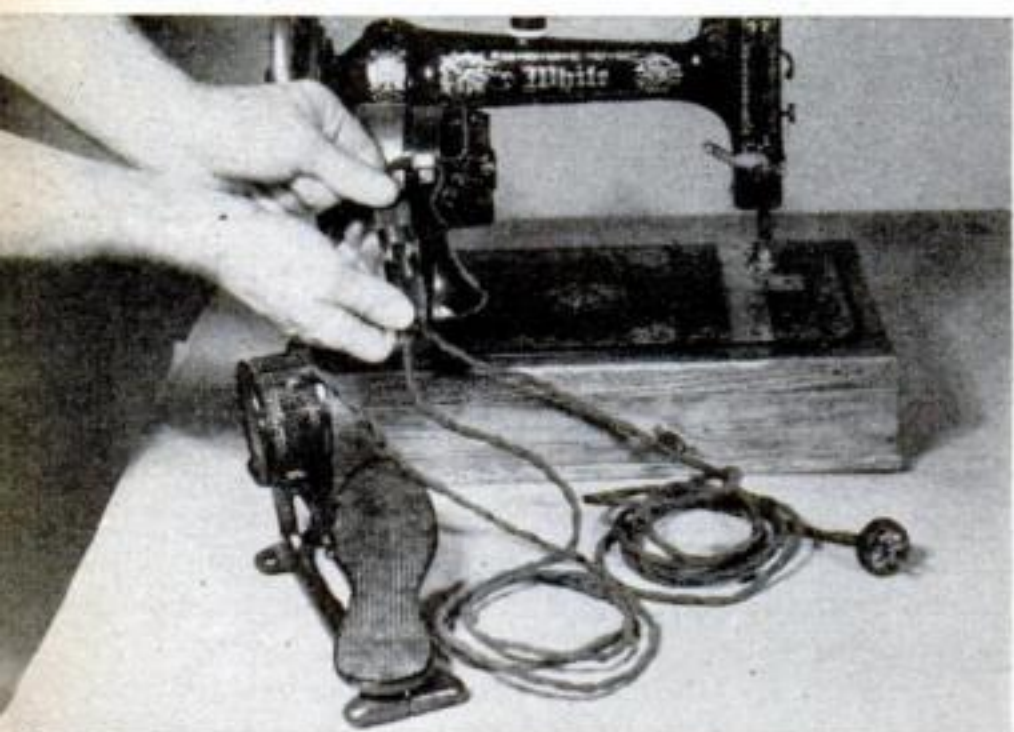




Hooked to the motor end cap and bracket, a spring applies tension between the pulley and handwheel.

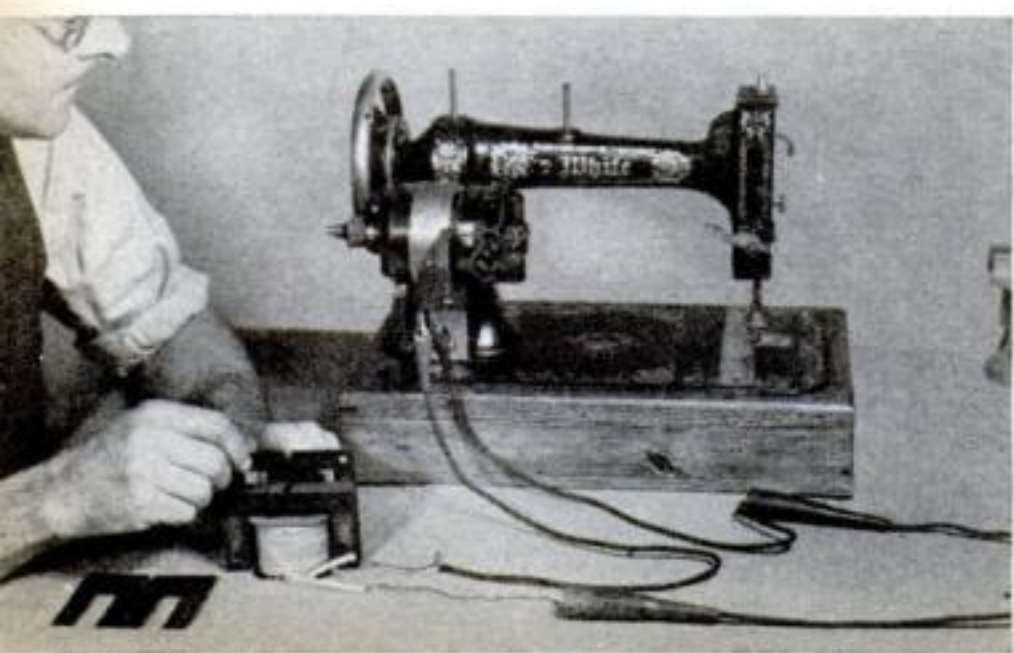


Bobbin winding is possible with a short belt that connects the old pulley with the winding spindle.



Here a secondhand foot rheostat is connected up. A homemade control is shown on the facing page.

Testing determines the number of E laminations required for the core of the homemade control.



is caught over any suitable projection on the motor or held with a single screw to the motor end cap. An anchor for the spring is provided by a flat piece secured to the lower mounting bolt.

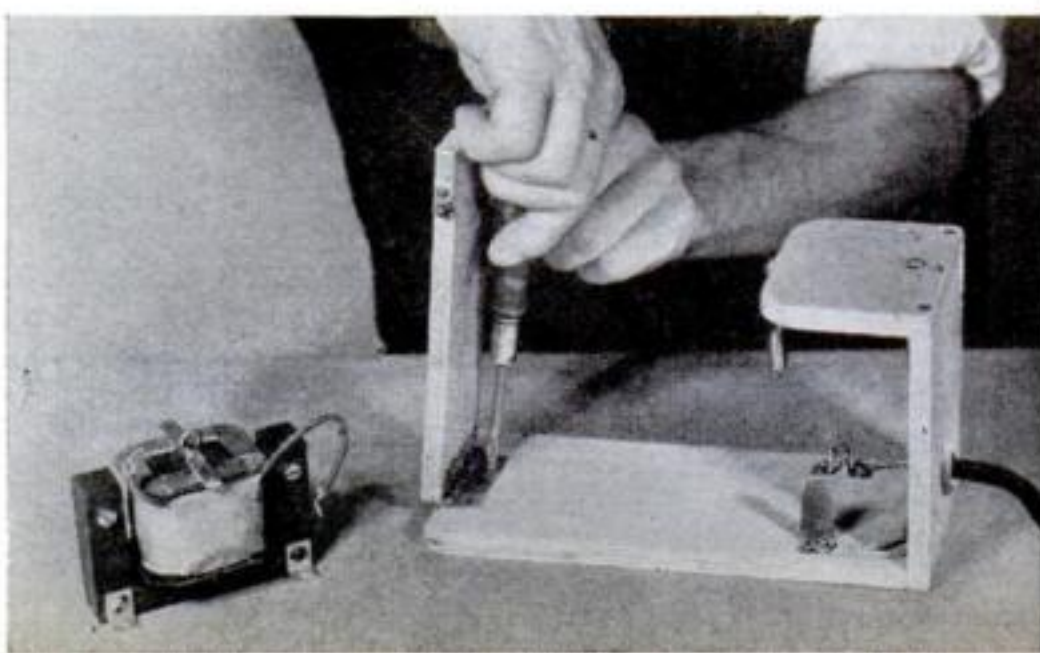
For use when winding thread on the bobbins, make a short belt to fit over the original belt pulley and the spindle pulley. It can be thrown off and hooked over the rear spool spindle when not in use.

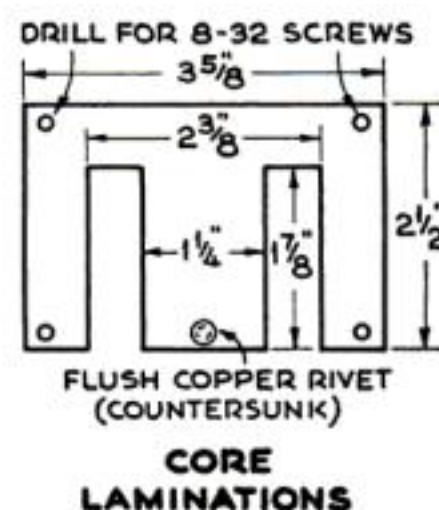
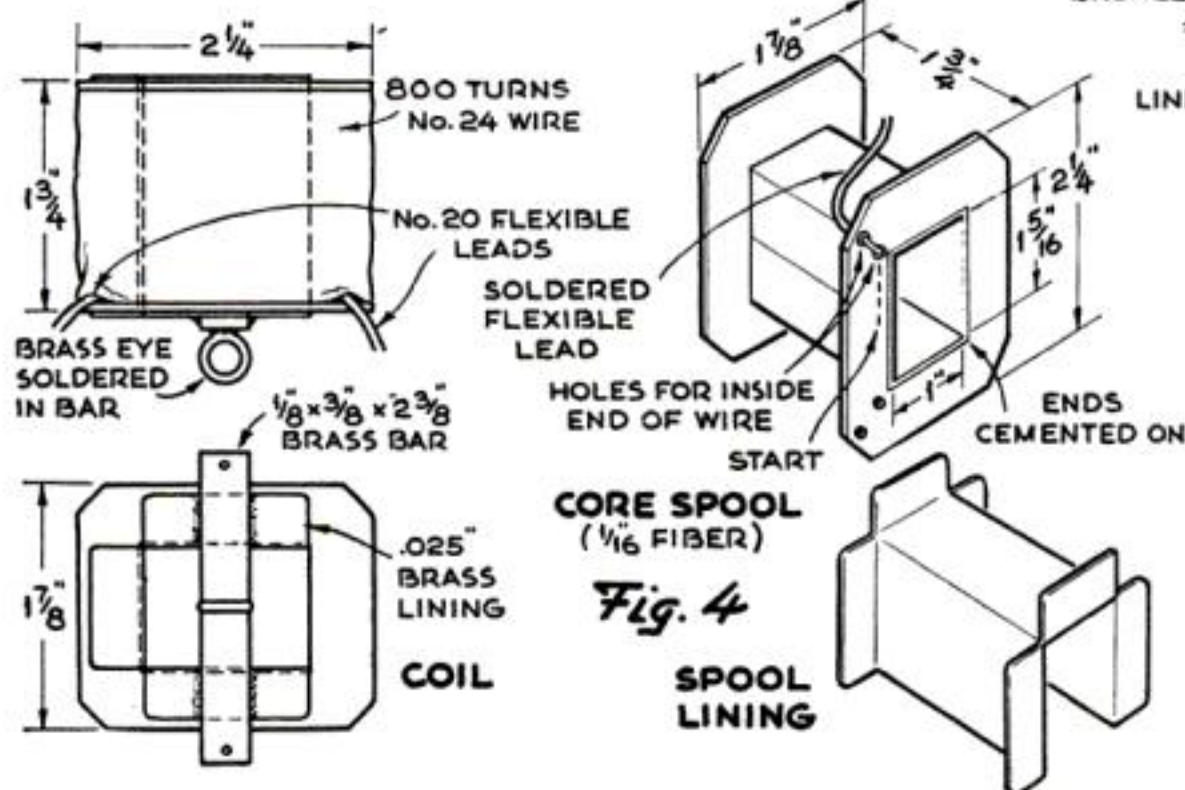
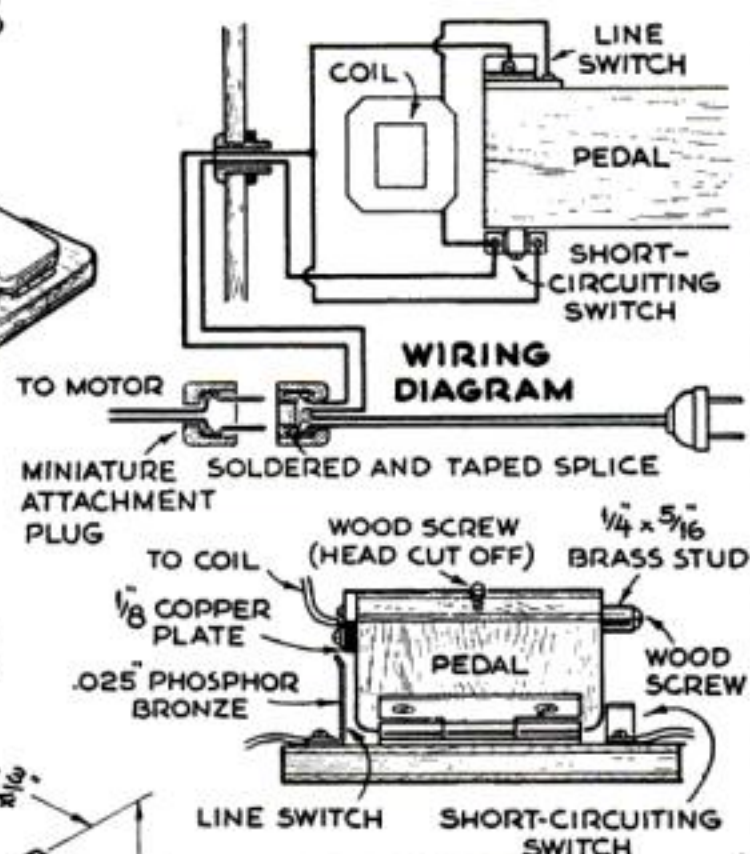
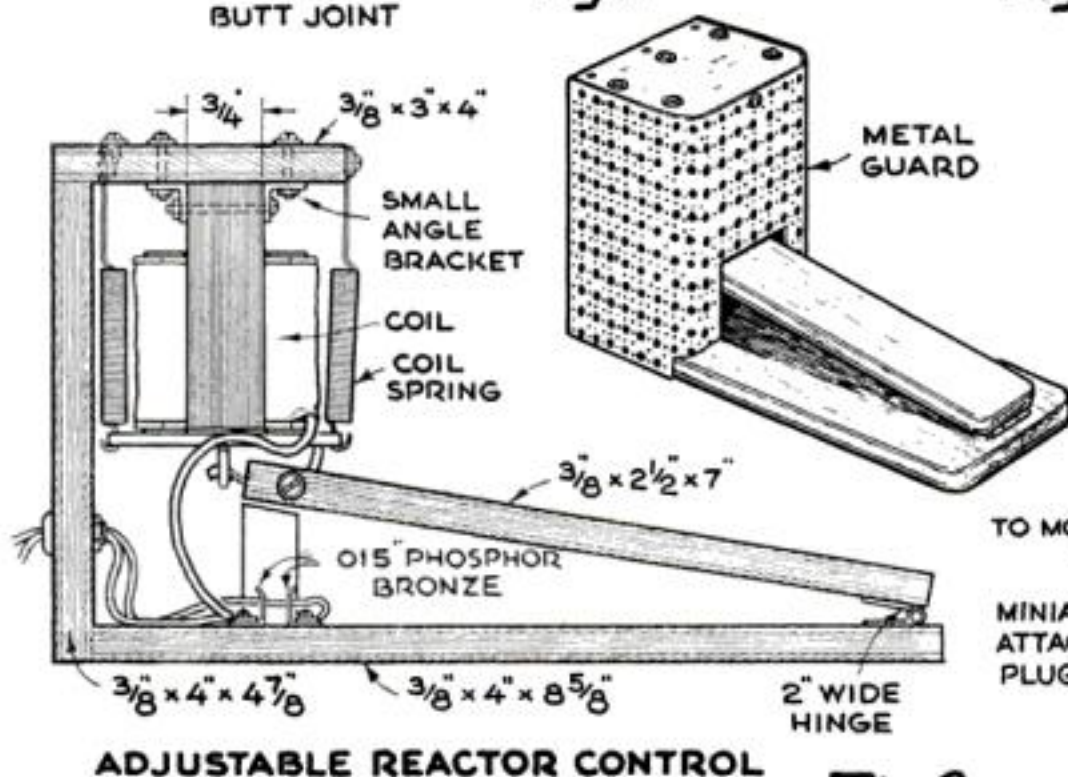
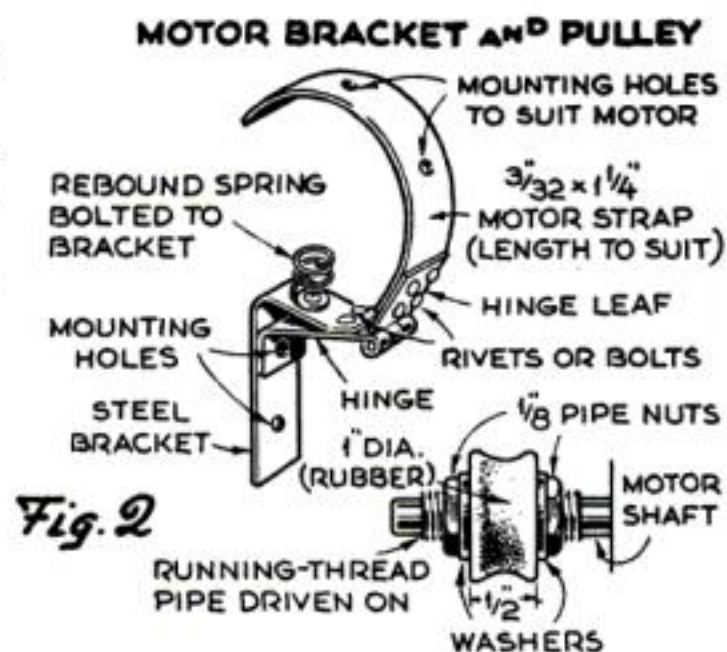
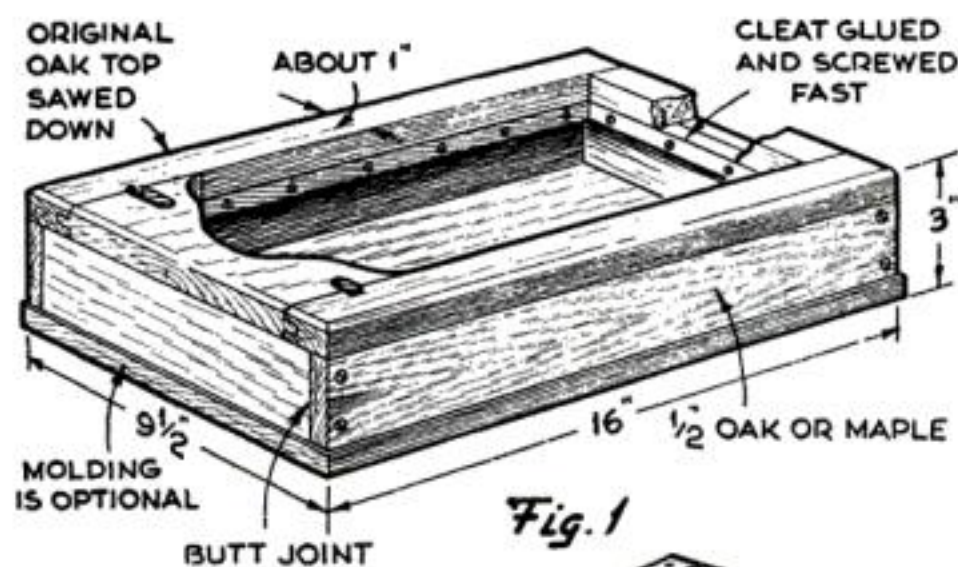
A miniature attachment plug, shown in one photo and also in the drawing, will make it unnecessary to have the cord trailing when the machine is stored. Both the line and control cords are run into the detachable half of the plug, and a joint is soldered and taped for a series connection as shown in the wiring diagram. If this joint is small and neat, it can be tucked into the cap without difficulty.

Use care in selecting a resistance control to be sure it will carry the motor current without overheating. If you do not have data on the full-load motor current and the capacity of the resistance unit, measure the motor current with an A.C. ammeter in series with one lead while the control is operating the machine. The capacity of the resistance may be stamped inside the control, or the maker may supply the information. In any event, watch carefully for signs of overheating when you first put the control into use. Some heat should be expected in normal use, but it should not be so great as to cause smoke or a smell of burning.

A practical control is shown in Fig. 3 for those who wish to build one from scratch. It is essentially a reactor with a movable coil actuated by a pedal. Maximum reactance is provided when the coil is all the way on its core, and this reduces the motor speed for slow operation of the machine. Depressing the pedal pulls the coil off the core and increases speed. When the pedal is nearly all the way down, the motor runs at almost full speed, retarded by the resistance of the coil winding only. A further push on the pedal causes a brass stud on its side to close the gap between two

Ordinary wood stock is used for the foot control, plywood for the pedal. Join them with a hinge.



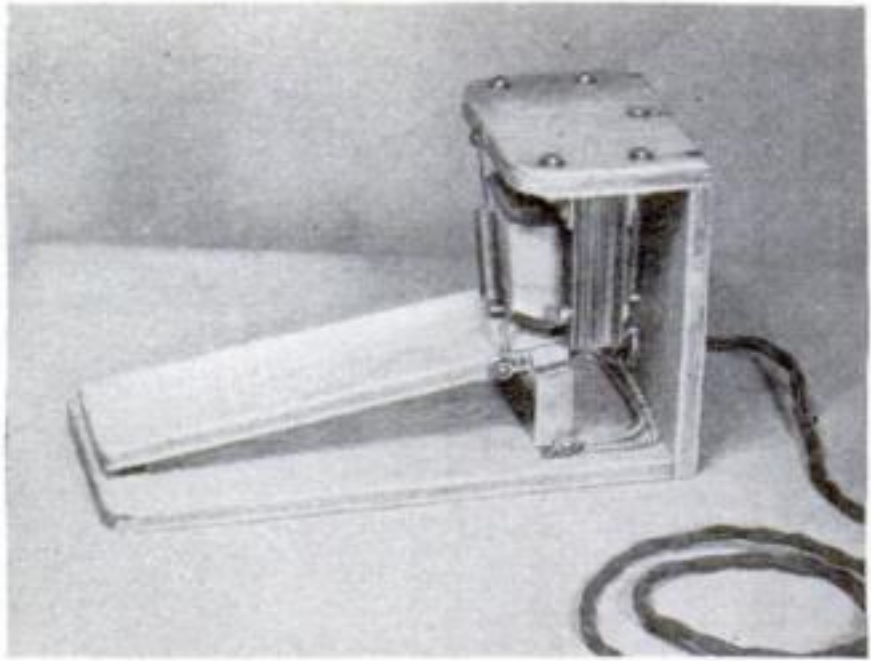
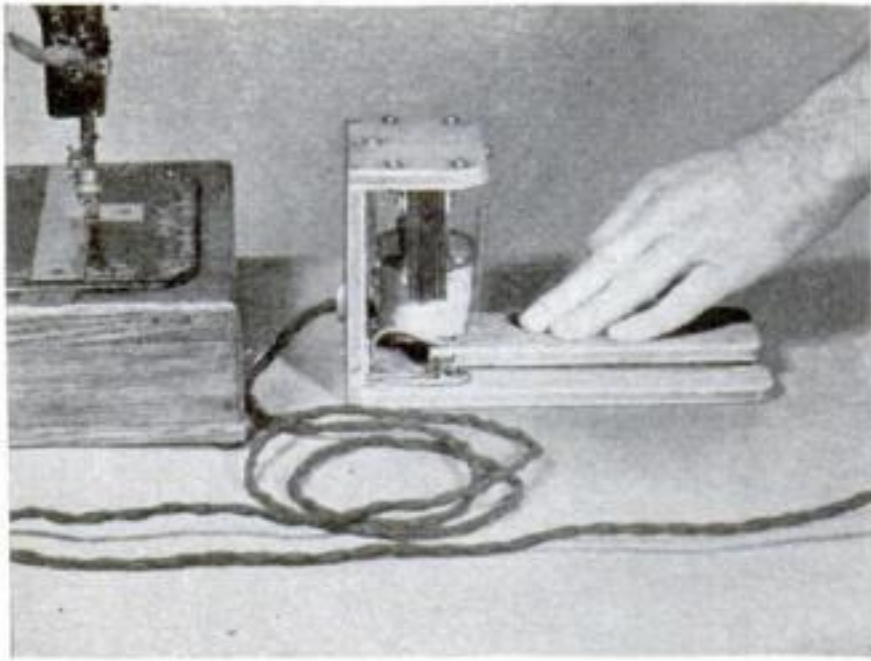


phosphor-bronze contacts, and this short-circuits the coil so the motor will operate on full line voltage.

One advantage of reactor control over resistance is that there is no loss in heating of the resistance wire. There also is no danger of overheating and burning out a reactor control, something that is quite common with resistance units.

You may need to experiment in making

the coil (Fig. 4) because details may vary with the motor it controls. First, there should be enough turns to provide some resistance so the motor will operate at a slight reduction from full speed when the coil is practically off the core. The turns should also be such that the insertion of a reasonable amount of iron will produce the desired speed regulation—the more turns, the less iron. [Turn the page.]



Full speed is obtained when the pedal is pressed all the way down (left); the line switch automatically stops the motor when pedal is up (right). A mesh guard shown in the drawing safeguards children and pets.

You might try winding about 800 turns of No. 24 enameled magnet wire, which in the average case should be a size that will carry the motor current without heating. It is a good idea to bring out taps at 100-turn intervals as the winding progresses, since this would make it possible to select the number of turns best adapted to the job. Test by connecting the coil in series with the line and the motor set up for driving the machine. Apply power, and the motor should drive the machine at practically full desired speed; short the coil with a jumper, and the speed should increase slightly.

Laminations can be taken from any old transformer used in radio or other apparatus, and since they must match the coil opening, it's a good idea to select them first and wind the coil to suit. Place these laminations one at a time in the coil, and

the speed should diminish until the machine is running very slowly. This is the amount of iron you will need. Remove the laminations and clamp them together with bolts and rivets as indicated.

Line the coil spool on three sides with .025" sheet brass to prevent wear on the fiber and to permit soldering on a brass eye bar. The lining is omitted from the fourth side because induced currents would heat the sleeve if the path were closed.

Engaging the eye on the coil is a long wood screw in a carefully drilled hole in the end of the pedal. After the screw has been driven in part way, the head is cut off and the shank is curved down with pliers, as indicated in Fig. 3. This stud provides the necessary flexible joint for free action when the pedal is pressed. Two light springs draw the coil up when pressure is released.

MULTIPLE RESISTORS

[ELECTRICAL]

When a resistor of a desired value is not at hand, it is often possible to combine two or more to serve the purpose. For example, if a 20-ohm resistor is wanted, two 10-ohm resistors can be connected in series. The total value of any number of equal or unequal resistors in series is found simply by adding their several values.

Resistors in parallel have a smaller total resistance than any single one of the components of such a combination. Where several of equal value are connected in parallel, the combined value is found by dividing that of one resistor by the number of resistors so connected. Thus four 10-ohm resistors in parallel would afford a total resistance of $2\frac{1}{2}$ ohms.

The value of two unequal resistors in parallel is given by the formula:

$$\frac{R_1 \times R_2}{R_1 + R_2} = R$$

EXAMPLE: One 20-ohm and one 10-ohm resistor are in parallel. Then: $\frac{20 \times 10}{20 + 10} = \frac{200}{30} = 6.6$ ohms

To calculate the value of three or more resistances of unequal value in parallel, the reciprocals (1 divided by the value in ohms) are added, their sum being equal to the reciprocal of the combined resistance. The formula is:

$$\frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3} = \frac{1}{R}$$

EXAMPLE: To find the combined resistance in parallel of 4, 7, and 14 ohms:

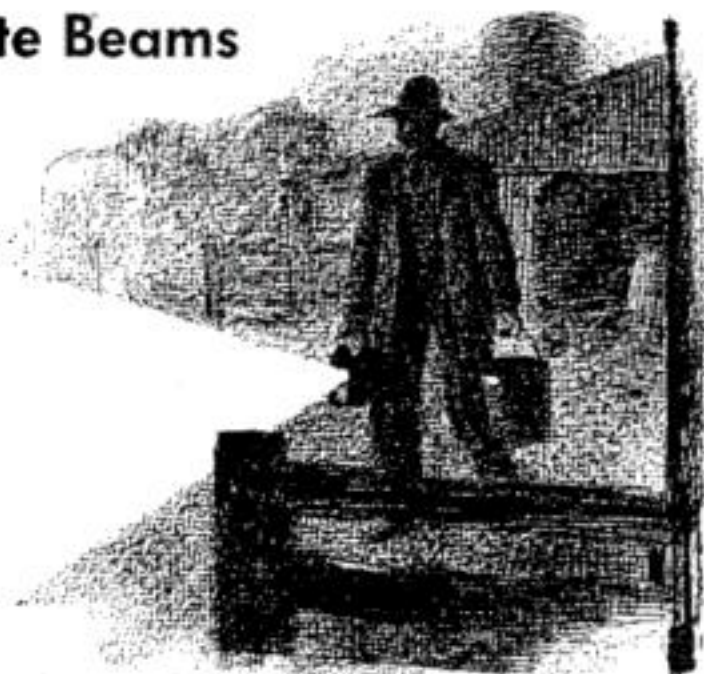
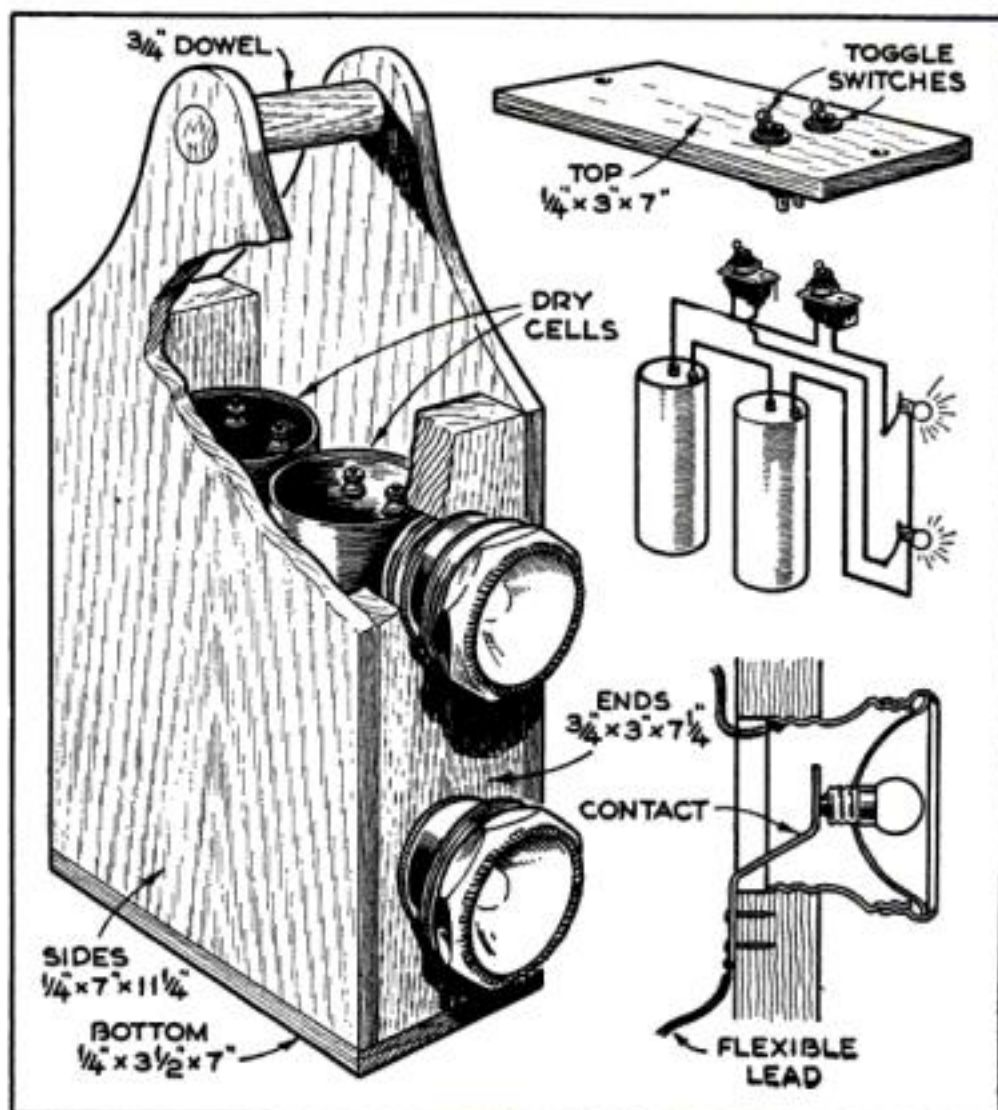
$$\frac{1}{4} + \frac{1}{7} + \frac{1}{14} = \frac{1}{R}$$

$$\frac{7}{28} + \frac{4}{28} + \frac{2}{28} = \frac{1}{R} \quad \text{OR} \quad \frac{13}{28} = \frac{1}{R}$$

This is solved by transposing: $1 \div \frac{13}{28} = R$ Inverting and multiplying, $\frac{28}{13} = 2.15$ ohms

POPULAR SCIENCE MONTHLY SHOP DATA FILE

Dry-Cell Lantern Provides Two Separate Beams



ends should be of $\frac{3}{4}$ " material. Bore two holes into one endpiece, just large enough to take a flashlight head. For the upper head a focusing spot is desirable, while the lower should give a broader beam. Two dry cells are connected through individual switches to the 3-cell bulbs. Special bulbs designed for dry-cell lanterns may also be used. The switches are placed within finger reach of the handle.

FOR portability and convenience, an ordinary flashlight has few rivals, but for heavy-duty use an electric lantern with both a focused and a diffused beam will outshine it on most counts.

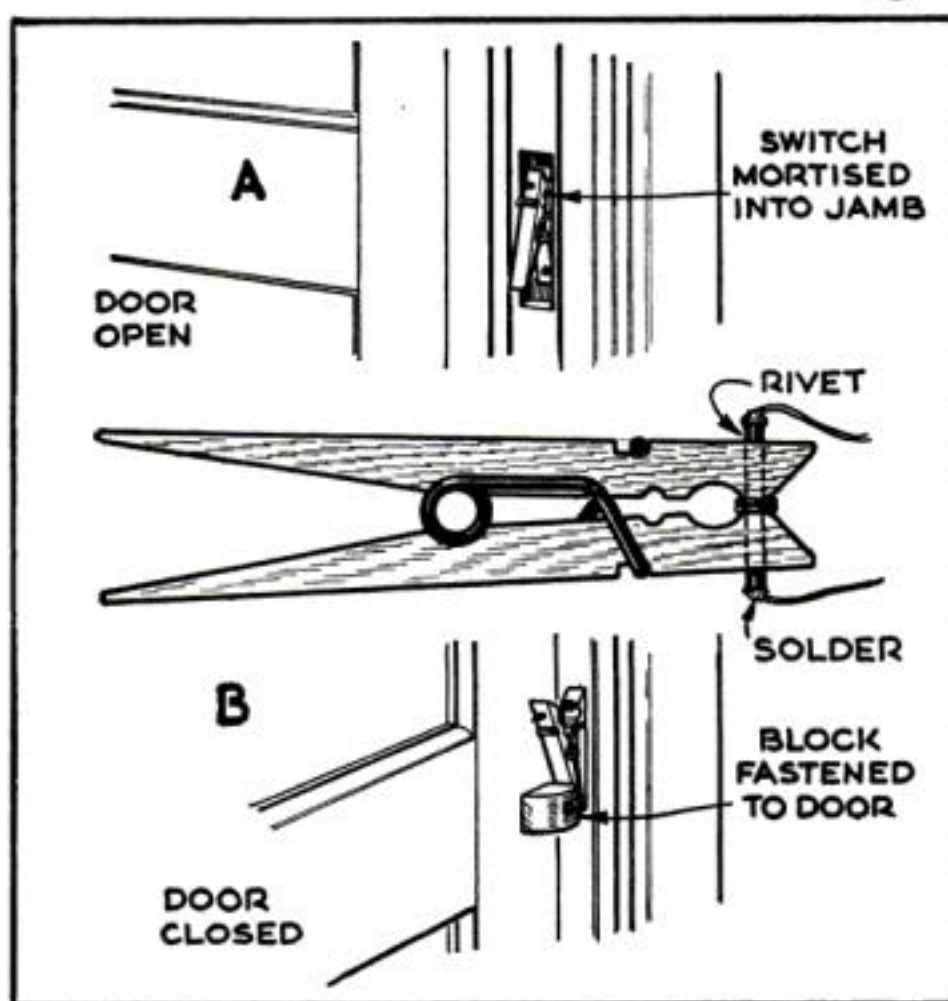
For the sides and bottom of the case, use $\frac{1}{4}$ " stock, preferably plywood. The

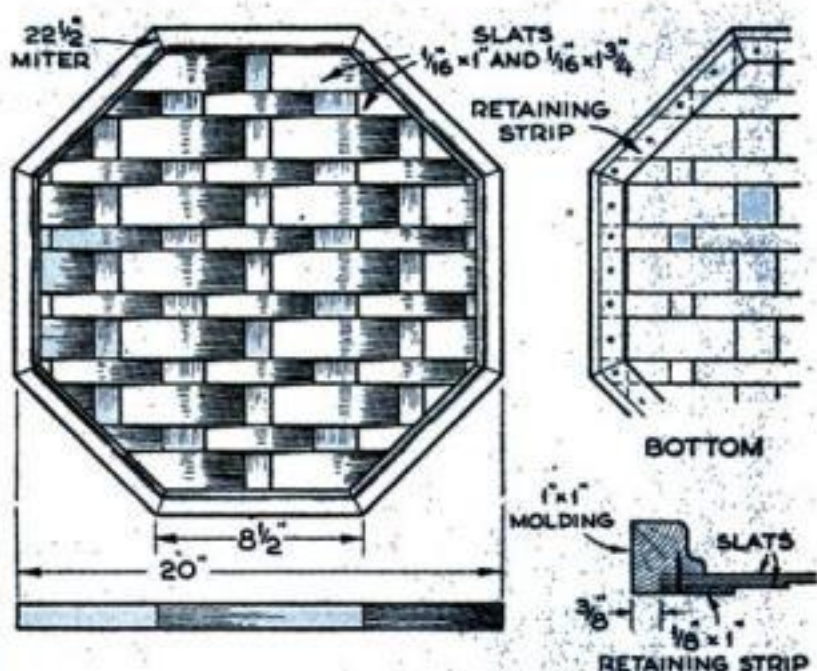
In wiring each flashlight head, attach one lead to the case either by soldering or by bringing it into secure contact with bare metal. The other wire should be connected to the center contact of the bulb by a strip of springy metal which does not touch the outer case.—HOBART SULLIVAN.

Spring Clothespin Acts as Automatic Switch for Low Voltages

NOTIFYING you by a buzzer or light when a door is opened is just one of many applications of this automatic switch. Burglar alarms can also use the switch, which is handy in numerous low-voltage circuits about the shop, home, and garage. It should not be made to carry 110 volts, though it can readily control 110-volt lights or devices by a relay.

The switch is made by converting a spring clothespin with the aid of two brass or copper rivets. Drill a small hole completely through both jaws and insert the rivets so that the heads make contact when the pin is closed. Then solder a lead to each. If installed in a door, recess the clothespin into the jamb as at A, or else attach it to a molding strip (B) so that a block on the door will touch the clothespin and break contact when the door is closed.—C. L. FARLEY.

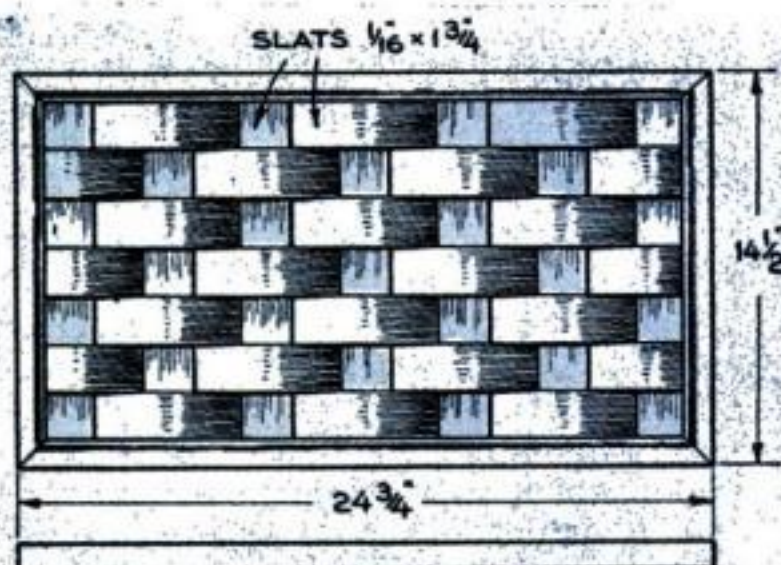
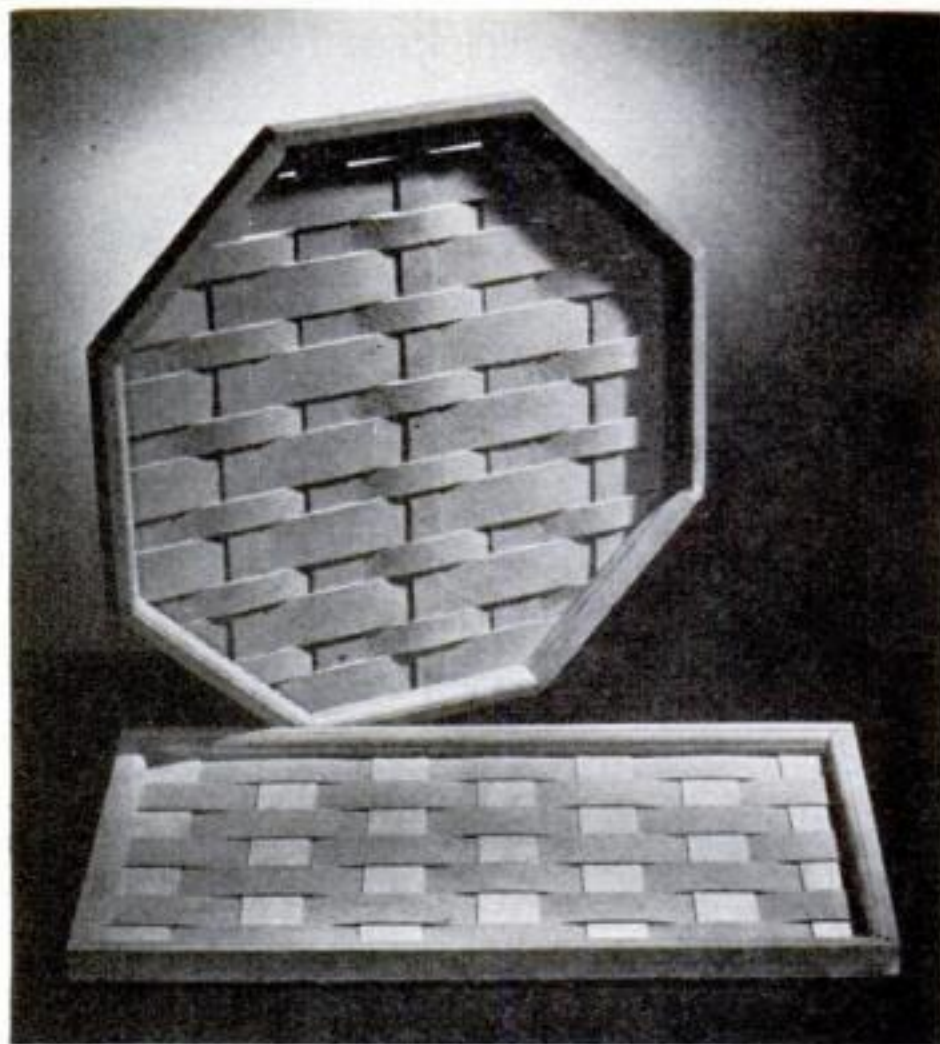




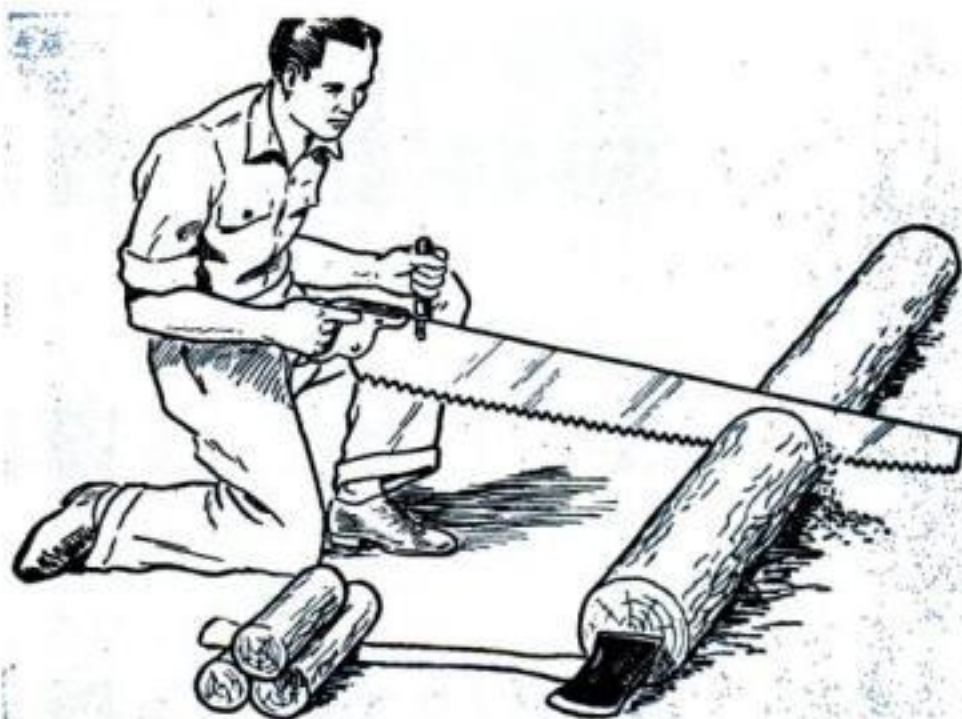
Rustic-Type Woven Trays Are Good Circular-Saw Project

WOVEN trays, always useful in the home or summer camp, constitute an interesting circular-saw project; and if you do not have power tools at hand, they may also be made from stock molding and fruit-basket slats. The finished trays can be given a polished natural finish, painted, or left untouched.

Your personal preference will determine the size of the molding, but it is well to remember that if it is large the tray will be heavy. That used in the trays illustrated is 1" by 1" with a rabbet of $\frac{3}{8}$ " by $\frac{5}{8}$ ". For the octagonal tray, alternate strips 1" and $1\frac{3}{4}$ " wide were used. The strips, cut longer than needed to give room for trimming, were ripped $\frac{1}{16}$ " thick from scrap two-by-fours, and were woven into mats before fitting. Mitered joints were sawed for the frames and fastened with nails, the angle for the octagonal tray being $22\frac{1}{2}$ deg. A $\frac{1}{8}$ " by 1" retaining strip, mitered to fit, was nailed to the rabbeted bottom to hold the mat



in place. The stock in this case was redwood, but hardwood would do nicely and could be given a natural finish. Half the strips in the rectangular tray were painted light blue before being woven.—R. H. JENKINS.

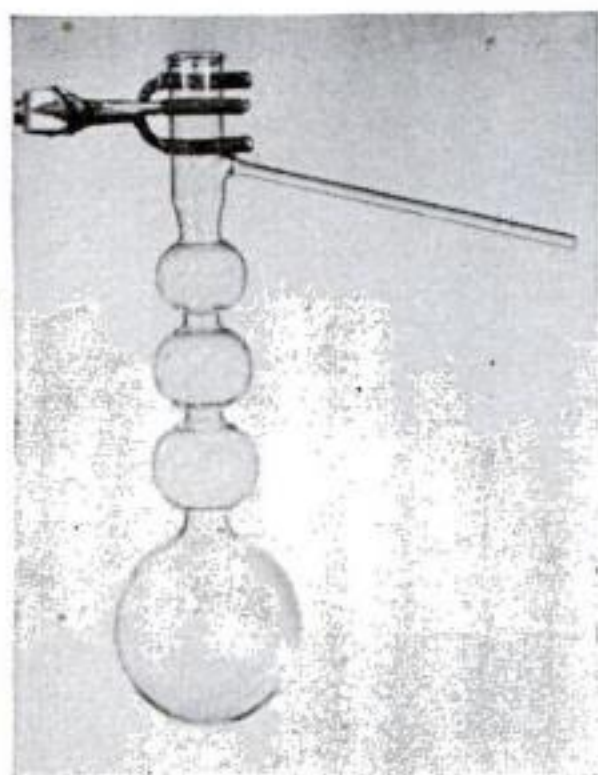


Ax in End of Log Keeps It Steady Under Saw

IF YOU have to cut light logs with a large saw, you will save yourself much trouble and get the job done much faster by driving your ax into the end of the log just a few inches off, and parallel to, the ground, as illustrated at the left. Weight down the ax handle with chunks of wood or other heavy objects that are handy, and the log will not roll as you saw. The same trick can be employed when two persons are using a crosscut saw.—ROY BOYT.

Question Bee

HOW MUCH OF THIS LABORATORY EQUIPMENT CAN YOU IDENTIFY?



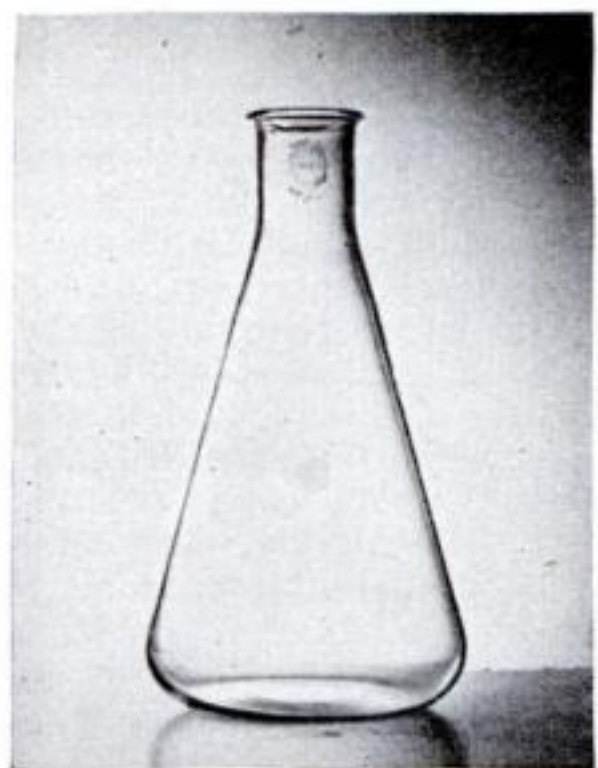
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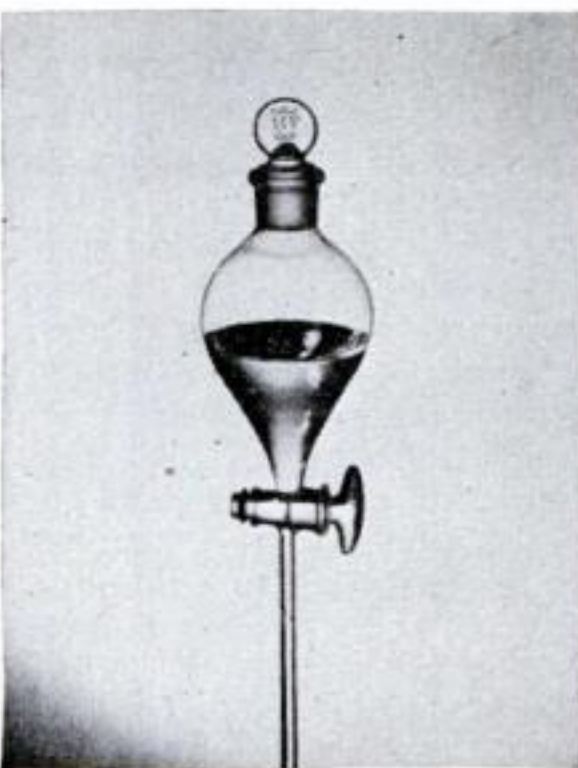
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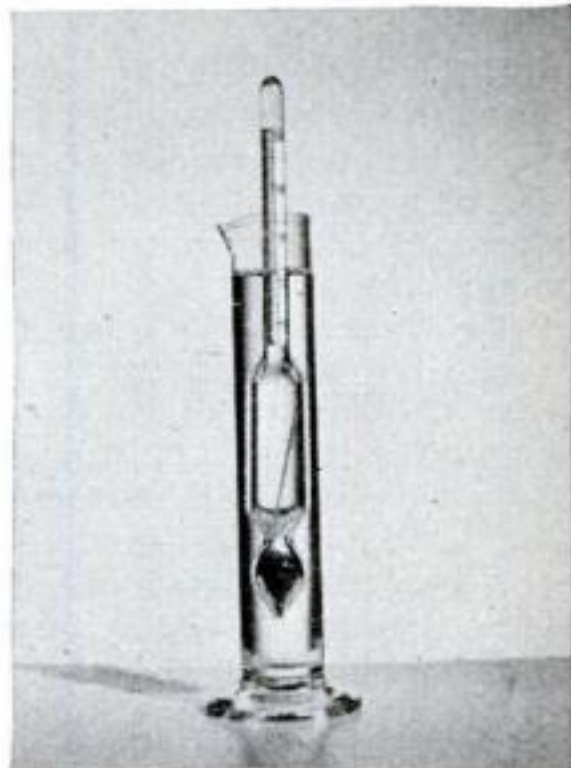
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5.....



6.....



7.....



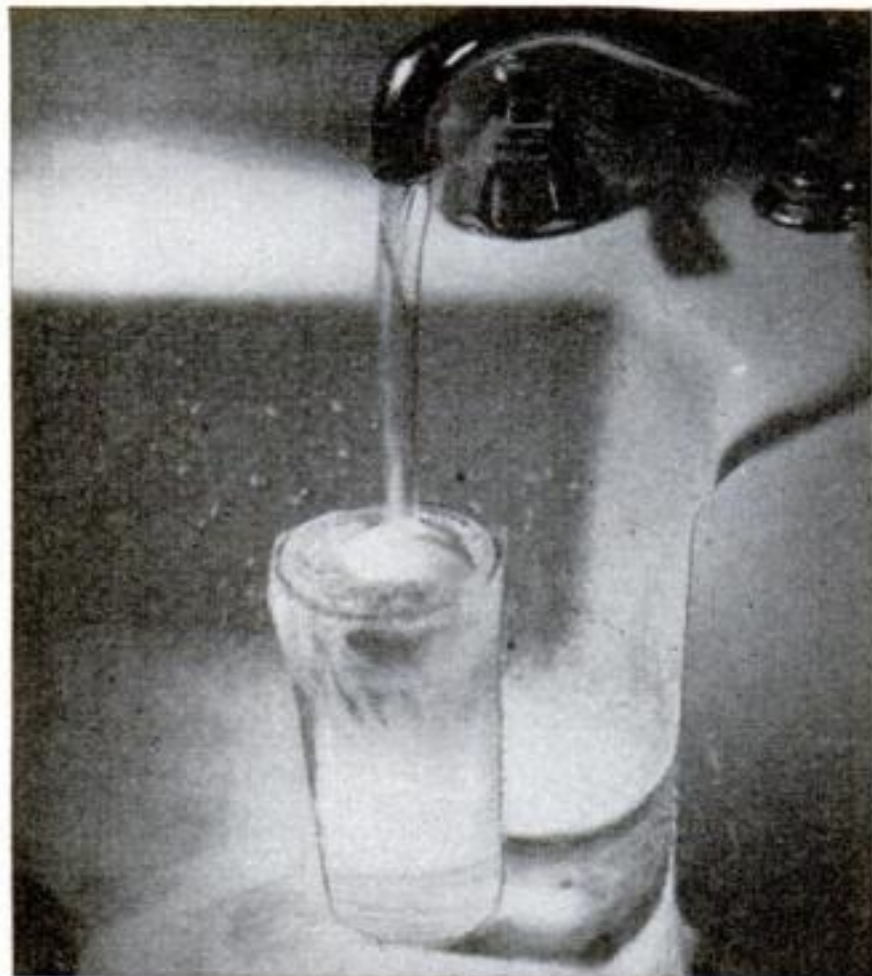
8.....

- 8. Evaporating dish.
- 7. Cork borers.
- 6. Hydrometer.
- 5. Separatory funnel.

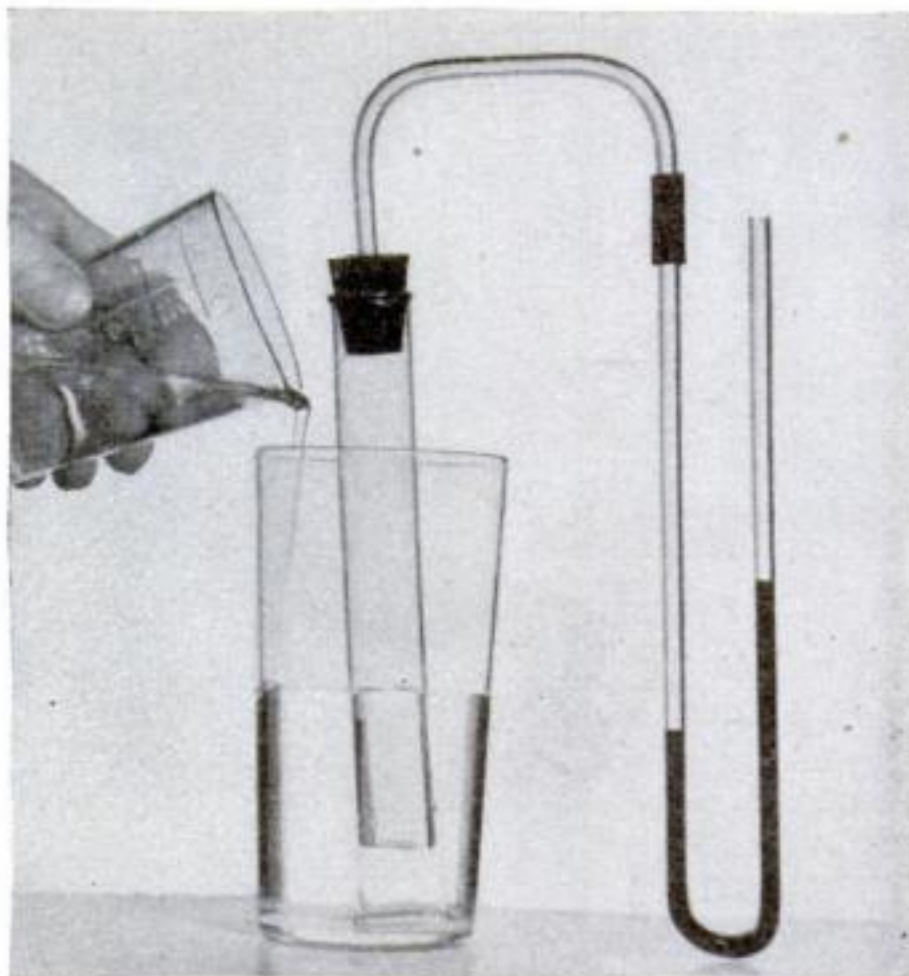
ANSWERS

- 4. Erlenmeyer flask.
- 3. Condenser.
- 2. Fisher burner.
- 1. Distilling flask.

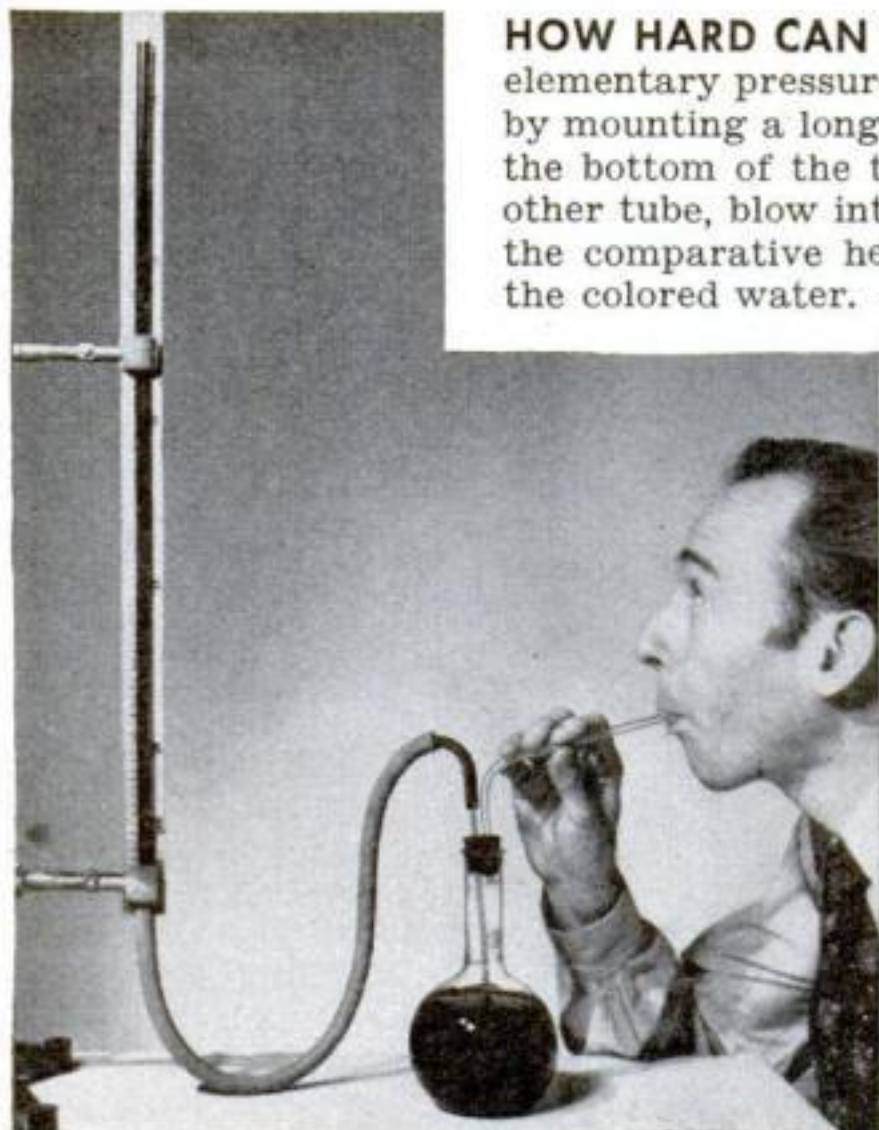
HOME EXPERIMENTS DEMONSTRATE



RAISING AN EGG by pushing it down demonstrates two important effects of pressure. Place a fresh egg at the bottom of a glass of water and direct a stream upon it. Instead of being pinned down by the flow, the egg rises to the top. And the harder you let the water run, the more strenuously will the egg try to jump out of the glass. Following the streamlines of the egg, the water flow curves under it and produces a higher pressure there. The Bernoulli effect is another factor; the fast-moving water next to the egg causes a lesser pressure than does the slower-moving water beneath it.



AIR-FILLED TUBES are capable of transferring changes in pressure over considerable distances, as can be illustrated by the miniature tank gauge shown above. A glass tube, open at the bottom, should be connected by tubing to a glass U-tube partly filled with colored water. If the open end of the first tube is placed in a tumbler into which water is poured, the colored liquid in the U-tube will be depressed in one leg and raised in the other. This movement is in direct proportion to the changing water level in the tumbler. A similar system is often used to measure liquids in large tanks.



HOW HARD CAN YOU BLOW? You can find out by means of an elementary pressure gauge, as shown at the left below. It is made by mounting a long glass tube against a yardstick and connecting the bottom of the tube to a bottle of colored water. Through another tube, blow into the bottle. You will then be able to measure the comparative heights to which different individuals can raise the colored water. Air pressure in the bottle does it.

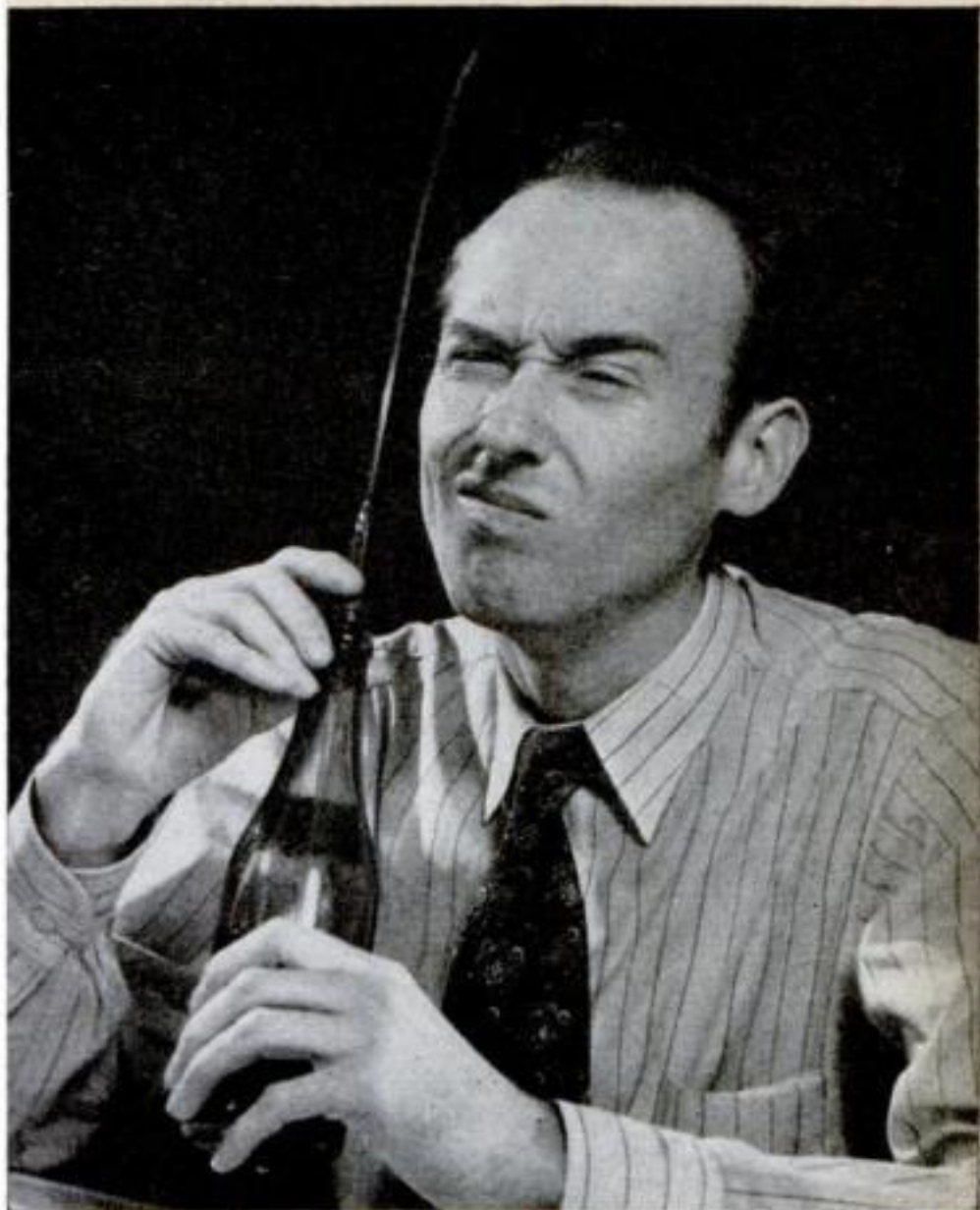
MOVIE LAUGHS have sometimes been evoked at the expense of the helpless fireman writhing in the throes of a bucking hose. Considering, however, that an equal but opposite reaction accompanies the high-pressure flow, hose handlers deserve a more sympathetic audience. A small reaction motor, right, which will enable you to show this principle, is made by plugging one end of a glass hydrometer tube with a two-hole stopper. Through each hole pass a glass jet bent as shown. If the tube is freely suspended and filled with water, it will spin around rapidly. The motion is produced by the reaction opposing the force with which the water issues from the jets.



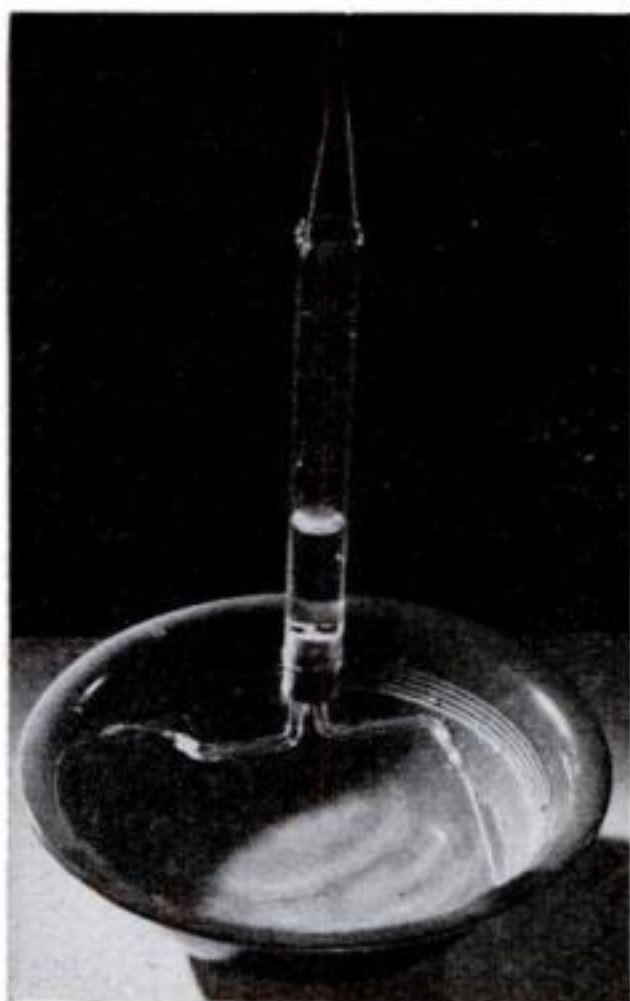
POPULAR SCIENCE

MECHANICS OF FLUIDS

HYDRAULIC ACTION alone can raise water higher than its original level, as illustrated by the action of the ram pictured below. From the elevated reservoir, a rubber hose leads to one end of a glass T-tube, while a short rubber tube is connected to the continuation. A jet is attached to the upright leg. Water flowing in the siphon pours steadily through the short rubber outlet. But by abruptly pinching this tube, you will cause the stream to spurt out of the jet to a height greater than the bottle. By diverting the horizontal momentum of the water, you increase for an instant the vertical velocity of the water streaming from the jet.



AN EYE-OPENER is this demonstration of some fundamental facts about air and water. Draw the upper end of a glass tube to a jet, and insert it, through a one-hole stopper, in a soda bottle half filled with water. The tube should reach almost to the bottom. Now ask some friend to prove his lung-power by blowing bubbles in the water. When he removes his mouth, he will be greeted by a forceful stream. Blowing into the bottle compresses the air inside; in expanding, the air forces water out.



CONVECTION is the movement of fluids caused by differences in density and the action of gravity. It can be demonstrated with the arrangement shown at the right. One of the two connecting tubes extends several inches into the upper bottle, while the other extends a similar distance into the lower. If the lower bottle is filled with warm colored water and the upper one with cold clear water, the denser cold water will seek a lower level, displacing an equal volume of the less dense warm water. A colored stream then rises through the other tube into the clear fluid above. The movement will continue until the temperature—and hence the density—is equalized in the two bottles.



How Strong Is That Acid?

**Titration, One of Chemistry's Most Important Techniques,
Enables You to Analyze Acids and Bases Quantitatively**

By KENNETH M. SWEZEY

NEUTRALIZATION is one of the most important and frequently used operations of chemical testing and manufacturing. By mastering the technique, you can determine how much acid or how much base a solution of unknown strength contains. Acids and bases are, of course, those two classes of substances that react to form salts. By combining acids and bases accurately, you can form dozens of new compounds for your experiments.

To demonstrate the principle of neutralization, all you need are a few grains of sodium hydroxide (common lye will do), a little hydrochloric acid, and a few drops of phenolphthalein solution.

Phenolphthalein solution, made by dissolving 1 gram of the chemical in 50 ml. of alcohol and then adding 50 ml. of water, is used as an *indicator* of basicity. Add just two drops of the solution to a base which you have made by dissolving about a gram of sodium hydroxide in 50 ml. of water, contained in a small beaker. A mere two drops turn the hydroxide solution a bright pink. As long as the color remains, you can be sure that the solution is still basic.

For your acid, mix about 3 ml. of concentrated hydrochloric acid thoroughly in 12 ml. of water. Add this acid very slowly to the sodium hydroxide solution, stirring the

latter constantly with a glass rod. When the pink color begins to lighten, add further acid only one drop at a time, using a medicine dropper. You will notice that at this stage parts of the solution will clear and then turn pink again. Continue even more slowly than before, pausing and stirring between drops. Finally, the addition of one last drop of acid will cause the entire solution to become colorless.

At this point, called technically the *end point*, acid and base have exactly neutralized each other. What remains in solution is a salt, which is neither acid nor basic. If you evaporate the water and analyze the compound that remains, you will find it to be sodium chloride. Thus, two substances which by themselves are poisonous have been transformed, by the simple magic of neutralization, into common table salt!

Many other salts may be made just as easily. Sodium hydroxide, for instance, neutralized by dilute sulphuric acid produces sodium sulphate; by nitric acid, sodium nitrate; by acetic acid, sodium acetate, and so on. Substitute potassium, barium, strontium, or other soluble hydroxide for the sodium, and your salt becomes a compound of one of the respective metals. Calcium hydroxide, cheapest of the bases, can be neutralized in the same way, but the pro-

Table of Weights of Acids and Bases in Standard Solutions

ACID	Formula	Molecular Weight	Grams Per Liter Normal Sol.	Grams Per Liter 0.5 N Sol.	Grams Per Liter 0.1 N Sol.
Hydrochloric	HCl	36.5	36.5	18.25	3.65
Sulphuric	H ₂ SO ₄	98.	49.	24.5	4.9
Nitric	HNO ₃	63.02	63.02	31.51	6.3
Phosphoric	H ₃ PO ₄	98.1	32.7	16.35	3.27
Acetic	HC ₂ H ₃ O ₂	60.03	60.03	30.01	6.00
BASE					
Sodium hydroxide	NaOH	40.	40.	20.	4.00
Potassium hydroxide	KOH	56.11	56.11	28.05	5.61
Barium hydroxide	Ba(OH) ₂	171.	85.5	42.75	8.55



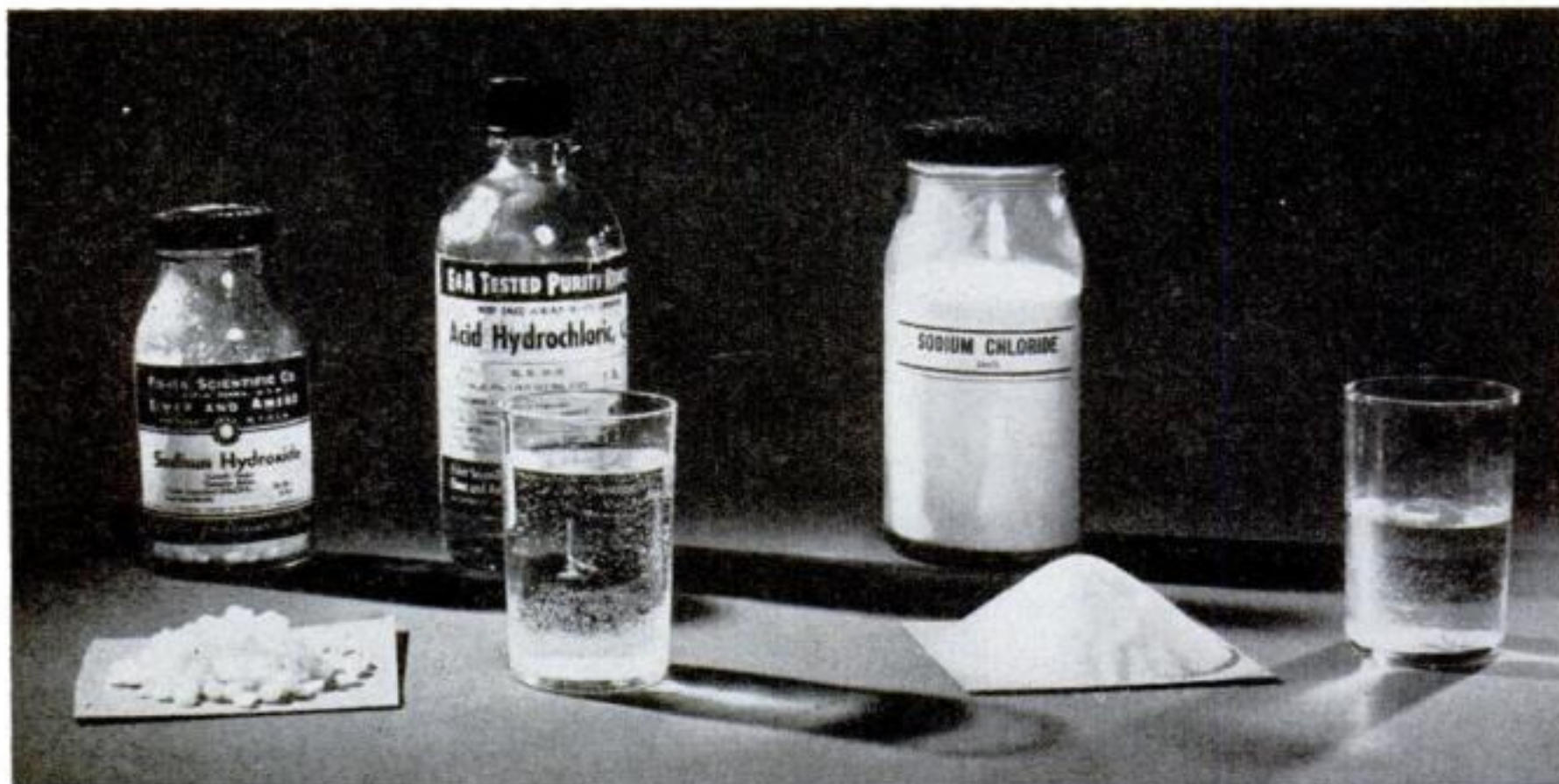
Two deadly compounds, hydrochloric acid and lye, neutralize each other to form harmless table salt. Acid is added a drop at a time to the base solution with phenolphthalein indicator in it (left above) until it remains colorless. The water is then evaporated (center). A taste test, at right, proves the residue is salt.

cedure takes longer because this chemical is only sparingly soluble. As soon as the dissolved portion becomes neutralized, more of the chemical goes into solution.

Insoluble hydroxides, such as those of iron and copper, also react with acids to form salts. The end point, however, cannot

be determined by the technique mentioned.

To understand how neutralization works, we must know what happens to acids and bases when they are dissolved. According to modern chemistry, an acid is a substance which in water solution dissociates or breaks up, producing as one component *hydrogen*



In the process of neutralization, acids and bases combine in exact proportions. Here 40 grams of sodium hydroxide and 36.5 grams of hydrochloric acid form 58.5 grams of sodium chloride and 18 grams of water.

ions—positively charged atoms of hydrogen. These hydrogen ions make solutions of acids taste sour. They turn blue litmus red.

Bases—metallic hydroxides, or combinations of a metal with oxygen and hydrogen—produce negatively charged *hydroxyl ions* when they dissociate in water solution. These are what make bases taste bitter and feel soapy. They turn red litmus blue.

Mix water solutions of acids and bases and what happens? Positive hydrogen ions unite with negative hydroxyl ions and form H_2O —plain water. Evaporate the water from the solution, and the remaining non-metallic element of the acid and the metal of the base combine, forming a salt.

Because acids and bases always unite in exact proportions, the process of neutralization provides a reliable and easy method of finding out the strength of solutions of these compounds. The measurement procedure is known as *titration*. It is one of the most important in the chemical laboratory. The procedure involves running a solution of acid or base, of standard strength, into a solution of unknown strength until neutralization occurs. The strength of the unknown then is readily calculated by comparing the volume of standard-strength solution needed to neutralize a given volume of the unknown one.

A long, accurately graduated tube, known as a burette, is used for measuring the exact amount of the standard solution needed for neutralization. Commercial laboratories generally provide a special stand that holds two burettes, one for acid and one for base, but a single one mounted on a ring stand is fine for the beginner. A 50-ml. burette, with a pinchcock, costs about a dollar.

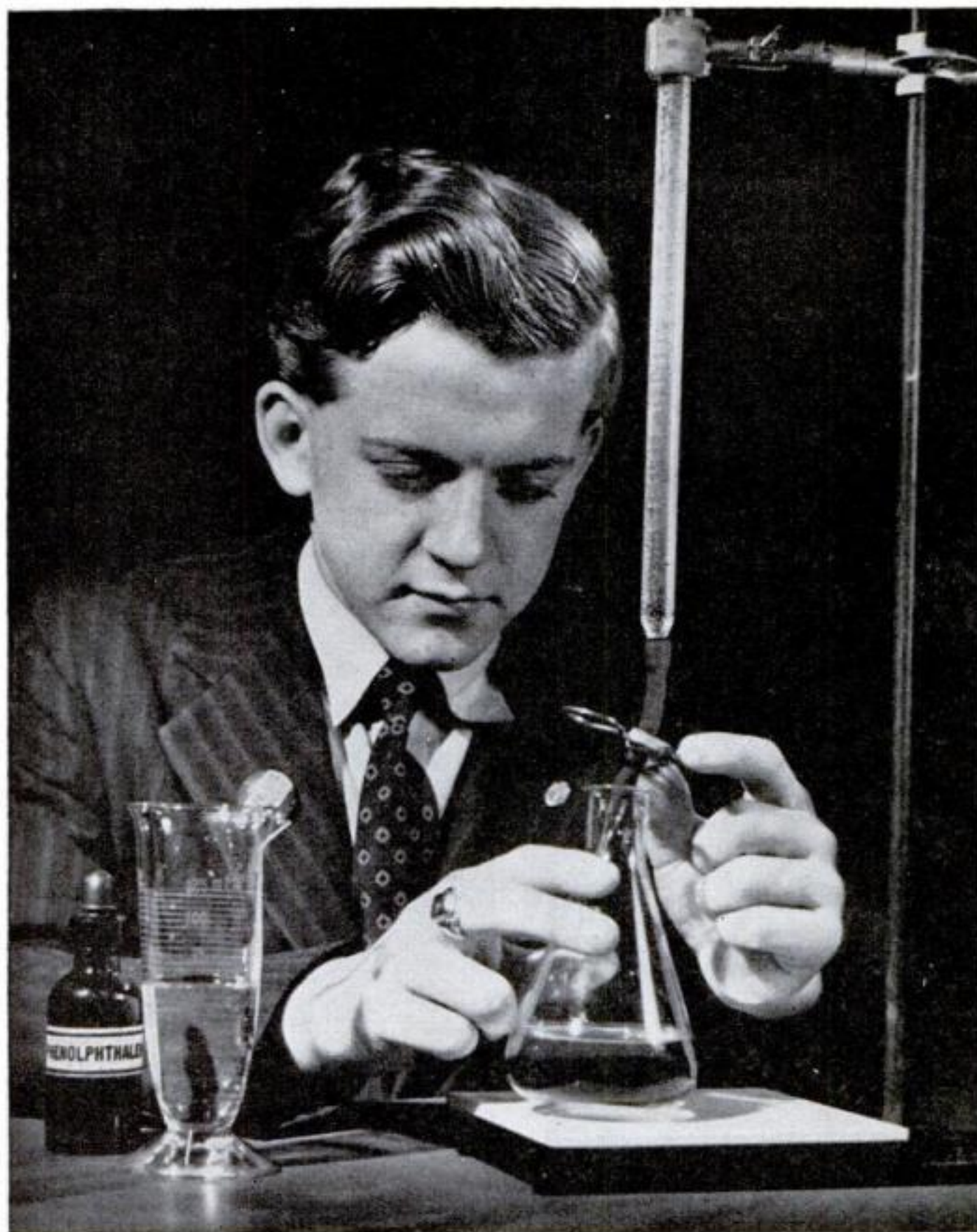
Standard solutions employed in the process of titration are called *normal* solutions, generally abbreviated as *N*. Solutions which are some decimal fraction of normal, such as .1N, .5N, and so on, also are used. Normal solutions are so adjusted that equal volumes of normal solutions of any acid and any base will exactly neutralize each other. For instance, a normal solution of acid contains 1 gram of hydrogen ions per liter and a normal solution of base, 17 grams of hydroxyl ions per liter.

Hydrochloric acid generally is used for making standard acid solutions. However, since it really is a water solution of a gas varying considerably in strength, we might get greater accuracy by using sulphuric acid. Dissolve 26.6 ml. of concentrated sulphuric acid by pouring it slowly into four times its volume of water; then dilute to exactly one liter. This will result in a solution very close to normal. Solutions of .5N and .1N may likewise be made by using 13.3 ml. and 2.66 ml., respectively.

Sodium hydroxide is the base generally used. If 42.5 grams are dissolved and diluted to a liter, you should have an approximately normal solution of base.

Equipped with these standard solutions and a burette, you'll have the means of determining the strength of solutions of most common acids and bases. Suppose, for instance, that you want to check the acetic acid strength of a particular brand of vinegar. (It would be best to use white vinegar so as to avoid any color confusion).

Put a measured amount of vinegar, say 20 ml., into a small beaker or flask, and add two drops of phenolphthalein solution. After filling the burette with normal sodium hy-



Accurately measured amounts of standard solutions of acids and bases, and a burette, at right, make it possible to determine the exact strength of unknown solutions of acids and bases. This process is known as titration. The burette reading is taken from the lowest part of the curved upper surface or "meniscus."

droxide solution, open the pinchcock slightly, allowing the excess base to run off until the surface is exactly at the zero line. Notice that the numbers on the burette read from the top downward. Always sight directly through the burette in observing the volume of solution it holds, keeping your eye at the level of the lowest part of the curve of the liquid surface, which is known as the meniscus.

Now place the beaker of vinegar under the burette and let the basic solution run slowly into it. Swirl the beaker constantly or agitate the solution with a stirring rod. The mixture eventually will turn partly pink, but the color will disappear with further swirling. From then on, let out the hydroxide drop by drop. When, with the addition of one drop, the solution remains pink, the

end point is reached and titration finished.

Finally, compare the volume of vinegar used with the volume of base required to neutralize it. Suppose you needed 10 ml. of base to neutralize the 20 ml. of vinegar. Obviously, the vinegar is just half as strong as the base, or .5 normal. By referring to the table on Page 200 you see that a .5 normal solution of acetic acid contains 30 grams per liter. Since water weighs 1,000 grams per liter, this proportionate weight of acid means your vinegar is a 3-percent solution.

By reversing the procedure—putting a measured quantity of base into the beaker and an acid solution into the burette—you can determine the strength of base solutions. In this case the solution is pink at the start, and clears at the end point.

Secrets of German Jet Planes *(Continued from page 126)*

Thus it can be seen that while the ME-262 and 163 both operate on Newton's law: "to every action there is an equal and opposite reaction," ultimate propulsion is obtained by two diverse methods. In the "Blitz-bomber" the turbo-jet units pressurize the sucked-in air and burn it, whereas in the ME-163 "Komet" explosive chemicals in solid or liquid form are burned without reliance on the atmosphere outside. However, in both cases violent reaction is diverted through a jet orifice at the tail. Just as you shoot a gun and receive "kick," so in jet propulsion you obtain tremendous thrust from the pressurized, swiftly ejected gases.

Though it appeared first, the rocket-propelled ME-163 is the most unconventional of all German jets. It is actually an application of the "single-seat interceptor fighter theory" as promulgated 15 years ago by the introduction of the Hawker Fury (Hornet). Faster than the ME-262, the Komet possesses a terrific rate of climb. What it sought to do was to reach the bombers as rapidly as possible, attack, evade, and land. This scheme of maneuver was ordained by its limited range and high fuel consumption. The rocket unit contains its own oxygen supply carried right in the fuselage. When this is exhausted the ME-163 must refuel. Flight duration can be prolonged only by sustained periods of gliding with occasional bursts of "squirt." Twenty-two minutes of "squirt" is the best Nazi scientists were able to instill. In the beginning they had only eight.

This high rate of fuel consumption largely influenced the design of the Komet. The pronounced sweepback allows disposal of a great weight of fuel in the rear section of the fuselage without any appreciable change in the center of gravity as the fuel is consumed. Throughout its short, squat, well-streamlined features, weight is saved in every possible way. To achieve this in early models, the undercarriage was jettisoned after take-off and landings were made on a skid attached to the bottom of the fuselage. Later models employed retractable landing gear.

At first the Komet was successful in shooting down some Allied planes, surprising the aircraft by high-speed runs out of the sun. This encouraged them to try lightning attacks on our heavy-bomber formations. With great elan they would flash up and down the bomber stream, striving to dismember formations so that the conventional fighters could pounce on the stragglers and

initiate mass-wave attacks. At other times the ME-163's would merely shadow the bomber stream, remaining aloof for the most part, then occasionally darting in for a quick pass from almost straight above or a roller-coaster attack from high nose to high rear. At comparable speeds they were able to turn with the best Allied fighters. The trouble was, they seldom kept their speed down to where this ability could be effectively employed. Interceptions of our bomber formations by the Komets were sporadic and ill-timed, for the most part; most often disastrous to the attacking jets.

For versatility and performance the ME-262 Blitz-bomber outstripped its squat predecessor in nearly every department except climb and velocity. Powered by two turbo-jet units slung in nacelles under the wings, this jet is a single-seat fighter of exceptionally clean lines. Its square-tipped wings sweep back severely. It has a slim, pointed fuselage with a teardrop, wide-vision cockpit canopy and a tricycle undercarriage. A small gas engine is carried to start the jet turbines which propel the all-metal frame. Fuel tanks are housed in the slender fuselage.

An interesting feature of the ME-262 is a device that enabled the pilot to catapult himself, his parachute, seat, and cockpit canopy from the body of the jet in cases of emergency, so that even at high speeds there was little risk of injury involved in bailing out.

A armor as thick as 15 millimeter in some places and at least four 30-millimeter cannons in the nose permitted employment of the ME-262 as a fighter, as a fighter-bomber, and in ground attack. When armor-stripped, it also was used for photo reconnaissance. The lighter-armed Komet showed little inclination to pit its superior speed against the tactical proficiency of our fighters. "It would be similar to our pilots' going duck hunting with an elephant gun," explained an enemy reaction expert. On the other hand, the ME-262's mixed it up on occasion, relying on zip as well as their somewhat heavier protective armor.

As in the case of the ME-163's, interception of our heavily escorted bomber streams by the twin-jet Blitz-bombers proved unprofitable. Allied fighter screens were able to cope with these jabbing tactics by virtue of overwhelming numerical superiority. Our small scouting units swept out ahead and astern of the main bomber forces, combing the clouds for the Blitz-bomber's long vapor

contrails or the broken puffs of the Komet.

A typical case happened on a mission to Osnabruck late in 1944. Five Blitz-bombers, attempting to split a formation of heavies, were suddenly engaged by chaperoning P-51 Mustangs.

"I dived on the ME-262's," reported the Mustang leader, "and was closing in when one saw me. He leveled out into a shallow turn and high-tailed it. Obviously his speed was greater—something over 500 per, I thought. But just then I caught one of the others turning in front of me. They didn't use any co-ordinated tactics. I fired two quick bursts that tore off his port engine. The pilot bailed out at 5,000 feet and the jet crashed into a burning heap." The other jets were dispersed, but saved themselves by outspeeding the Mustangs.

In attacks on Allied installations behind the lines, the Blitz-bombers used two 551-pound bombs fitted under the fuselage. They whipped in toward the target at 1,000 feet, diving to 500 just before the bombs were released. This extra bomb load slowed up the ME-262's to such an extent that they often required escort by conventional fighters to ward off our interceptors. Sometimes they attacked in pairs, utilizing high speed and quick change of altitude. Then they bombed and scrambled. In night bombing, the jets sped over silently. Troops on the Western Front called the ME-262 "the silent straffer" because it emitted no sonic warning.

The twin-turbo-jet Arado 234 was the last Nazi jet to come into operation. Allied pilots reported its performance and employment as similar to those of the ME-262. Both utilize tricycle landing gear, possess nearly the same armament, and are single-tailed monoplanes. The turbo-jets of the AR-234 differ somewhat in design from the Jumo .004's of the Blitz-bomber, more nearly resembling those of the Heinkel 280, another twin turbo-jet, which apparently was never carried beyond the experimental stage. The twin-tailed Heinkel appeared once or twice in surprise encounters, then disappeared. Its endurance was known to be around 40 minutes, only one half that of the ME-262, and its speed was slightly less.

Lest the foregoing chronicle of the German jets' capabilities and potentialities disproportionately magnify their influence upon the air war, it should remain clear that the jet did not prove to be the threat the High Command had expected it to be. The number of German jet planes used in combat was relatively insignificant. Potentially, nevertheless, the jet was a threat—just like the first Spitfire squadron in the battle of Britain or the first B-29 that bombed Tokyo.

Credit is due the Allied air planners for their vigilance in undertaking countermeas-

ures calculated to retard German jet production. Forewarned, they directed strategic blows against the experimental centers at Peenemunde and Rechlin. Chemical plants producing jet fuel were ferreted out and attacked, the installations of the Leipheim jet factory wrecked. Allied photo-reconnaissance aircraft kept watch for airfields with lengthened runways, which the jets would need to give them enough speed for take-offs. Once uncovered, these runways were postholed by air attacks and rendered temporarily unserviceable. This program of delay, accomplished without detracting from the long-range objectives of Allied airpower, upset the jet program. Moreover, the German High Command helped to stymie itself by floundering in the development of an effective tactical doctrine for what few jets it did manage to produce.

The War Department's announcement that in our forthcoming plane production a significant quota will be allocated for jet types invites speculation as to the role of the jet plane in the air war against Japan. Development and operation of jet interceptors by the Nips is not unexpected. It is common knowledge that Hitler provided his Oriental partner with technicians and patents. In the Iwo Jima fighting the Japs made effective use of the German rocket bomb. Furthermore, the available Jap conventional fighters capable of thwarting our high-flying, fast-moving Superforts are still too few. Based on present experience, Japanese planes give inferior performance at altitudes above 20,000, ideal for the B-29's. Consequently, a very fast interceptor—a jet plane—is badly needed at this altitude. Where a conventional fighter can make one pass from a preferred position, the jet with its remarkable speed can hit from any spot. But these potentialities are not causing our air experts much lost sleep. The War Department's disclosure presumes that there will be available enough American jets to counteract any Japanese threat. At least two types—one Army, one Navy—are in production.

When the record of this air war is safely chronicled in the annals of our Congressional Library, military historians are sure to note the jet threat as a significant but futile effort by the Nazis to wrest victory from defeat. "Too little and too late" must be the final verdict.

ARE you using the visual filing aid on the backstrap of this magazine? That red stripe will help you to keep your file copies in order, show when an issue is missing, and guide you in returning a copy to its place.

Words That Win Battles

(Continued from page 123)

by name tells them not to die "a stupid, meaningless death" as "we offer you life with honor." In translation, the text inside says: **SOLDIERS OF THE IMPERIAL ARMY!**

You have fought well, but the battle is lost. You are cut off with no hope of escape. Soon your food and ammunition will be gone.

You have only two fates—annihilation because unwise commanders sent you into our trap. Or good treatment behind the Allied lines.

Think it over. Ghosts in Yasukuni cannot help Japan. Death without meaning is only for fools.

Some of your friends know this. They have come over to us and they are safe. They are eating rice, smoking cigarettes, sleeping in peace. They know that life is precious. They are not ashamed to live.

Join them now. You will receive plenty of good food and kind treatment. Your identity will not be disclosed.

This is our only offer. If you do not accept it, we will be forced to destroy you.—**THE COMMANDER.**

Instructions are also given for surrendering. To guarantee safety, the Japanese are told to approach the Allied positions singly by day without arms, to raise their hands and wave this pass, and to follow sign directions of Allied soldiers. An English-language notice on the leaflet directs Allied soldiers to "treat the bearer courteously and conduct him to headquarters."

Bombs and leaflets are sometimes dropped together. The text of one leaflet headed "**WARNING**" and used in many languages in the Far East to hamper Japanese shipping and production in overrun regions is given in translation on page 121.

Leaflet newspapers, sometimes accompanied by packets of needles, garden seed, or chocolate bars, have helped keep hope alive in enemy-occupied countries. Airborne newspapers printed in London in the French, Belgian, and Dutch languages were dropped by the millions until these countries were liberated. The news of the landings in France was heralded with a leaflet carrying General Dwight Eisenhower's proclamation on one side, and on the other the dramatic headline: "**LES ARMEES ALLIES DEBARQUENT**" (The Allied Armies Land).

Another D-day leaflet asked French rail-

road workers and canal attendants to sabotage communications. Others warned residents of certain towns that they would be bombed during the day. A later leaflet asked Poles in the German army to join the Allies. During the first two weeks of last September alone, for example, 54,839,000 leaflets were flown from London. In addition, other leaflets, some bearing photographs of German generals who had surrendered, were printed in France and helped capture thousands of Germans in isolated pockets.

At Cherbourg and many other points, leaflets were followed by loudspeaker or "hog caller" appeals. Many surrenders were effected by this means. Trucks equipped with public-address systems of the sort devised for large outdoor meetings are used, with some modifications, for this work. A new-type lip microphone conveys the speaker's words to the amplifying equipment with a minimum of battle noise.

As equipment within earshot is also within gunshot, "hog calling," as soldiers term the operation, is the most dangerous form of war propaganda. Lt. Col. Flynn L. Andrew of New York City, Psychological Warfare Chief of the American First Army, and scores of others have lost their lives operating the sound units. To lessen the danger and make the sound carry farther, the loudspeakers are commonly placed in no man's land some distance from the truck and microphone. This has its risks. When the equipment went silent on one occasion, it was discovered that the Germans had come out of their positions and stolen the horns.

Backing up the short-range forms of propaganda is the ocean-leaping radio. Before the war, the United States had 11 short-wave broadcasting stations owned by General Electric, N.B.C., C.B.S., and others. Only WGEO at Schenectady had 100-kilowatt power. There are now twoscore stations, six of them of mighty 200-kilowatt power. The latter were built for the Office of War Information by the Crosley Corporation and the Federal Telegraph and Radio Corporation.

Before Pearl Harbor, there was one station, KGEI, on the West Coast. There are now 10. There is also a new 100-kilowatt station in Honolulu. Saipan has a new transmitter and there are stations in operation in the Philippines. Together, all of these give Japan and the Orient America's version of the war news on medium as well as short wave. Judging by the alarmed re-

action of Radio Tokyo, they are effective.

Evidence of the value of long-range radio broadcasting was found when southern Italy was liberated. Many persons were discovered in Fascist jails because they had been listening to the weekly Italian-language broadcasts of Mayor Fiorello LaGuardia of New York that had been short-waved to Italy by the OWI.

In preparation for the invasion of Europe, the OWI erected two powerful medium-wave broadcasting stations in North Africa and a third in England. One of the African stations used a second-hand, 50-kilowatt transmitter previously employed by WABC, the Columbia station in New York. The station in England was named the American Broadcasting Station in Europe and has come to be known as ABSIE for short. In addition, stations captured on the Continent were utilized as fast as they could be put

back in condition and returned to the air.

One of the stations captured with little damage was the 150-kilowatt Radio Luxembourg, second most powerful broadcast transmitter in Europe. Robert M. Pierce, chief engineer of WGAR in Cleveland, then with the OWI, was commended by military authorities for his speed in returning this station, which could be heard throughout Germany, to the air.

The repair work was enlivened by an incident involving a native employee of the station. He explained that he had worked faithfully there for many years and that, before they departed, the Germans had promised him an increase in salary. He said that he needed the money and thought that the Americans should give it to him. After a little consultation, they did so. This expedited the repairs and was considered good propaganda.

The War on Fire

(Continued from page 109)

nozzle, and a five-gallon can of the "soup."

A brown-hued liquid not too pleasant to the nostrils, "Navy bean soup" combines with water to make a wedging, smothering mass of snowy bubbles several inches thick that will remain for hours wherever it is plastered. It seals gases in, seals oxygen out.

You can cover the side of a barn with foam, and there it will stick. Its adhesive quality is invaluable in preventing "flash-backs"—the rekindling of fires after they appear to be out. Nothing short of a hurricane will blow it away. It can be built up into dikes to keep gasoline fires within a given area.

When U. S. Marines invested the Marshall Islands early last year, the carrier *Enterprise* was struck by a Jap bomb that fired her flight and hangar decks. High-test gasoline blazed high. The ship's fire-fighting crews, using "bean soup" alone, put out the fires in just one minute.

A tanker, colliding with another vessel off the Virginia Capes, burst into flame. Most of its 107,000 barrels of inflammable cargo was aviation gasoline. A full 12 hours after the fire began, a special Navy fire-fighting crew arrived from Norfolk. "Bean soup" saved half the tanker's load.

Proteins derived from fish scales, horns, hoofs, animal blood, and the waste products from slaughterhouses also are used in manufacturing "bean soup."

H. E. Mattin, of the Mearl Corporation, Eastport, Me., produced a foam that was even tougher. By introducing iron salts into his stabilizer, he was able to make foam

with bubbles that got firmer and more resistant with the application of heat. The Navy is buying all the "bean soup" he can manufacture.

The Army is more partial to water fog and carbon dioxide gas, though it uses foam liberally as a secondary agent to prevent flash-backs. The Air Corps was experimenting with fog—generated with the kind of nozzles used in spraying trees—as far back as 1934. It was not until 1942, however, that water-fog fire-extinguishing trucks began to roll off factory assembly lines in volume.

The man responsible for them was William W. Dean, one of the world's foremost fire-fighting engineers. Employed originally by the Quartermaster Corps, he also "bulled through" the construction of equipment to fight fires. In later years he has worked for the Engineer Corps, to which the job of fighting fires was transferred.

Fog is of peculiar value to crews fighting fires resulting from airplane crashes. Saving what remains of the airplane is incidental. Saving the flying personnel is paramount. High-pressure fog is directed at the plane to make the heat bearable for the men inside until they can scramble out or be rescued. If the airplane is big, a special sharp-beaked fog nozzle called a javelin is rammed through the fuselage to help cool it from the inside.

Fog is so effective in reducing the temperature of highly flammable substances that in one test conducted by the Coast Guard in an abandoned Liberty ship, less than 7,000 gallons of it lowered the temperature of 5,000 gallons of bunker oil set

ablaze in the engine room from 410 to 164 degrees in 37 minutes. It was estimated that only 500 gallons of oil were consumed.

A by-product of fighting fire with water under considerable pressure is known as "blast effect."

Water under pressure of as much as 600 pounds to the square inch directed at airplane fires blows away burning gasoline and its vapors. A homely example of blast effect is the diving trick often used by airplane pilots in the past to blow out the flames when fuel in their carburetors caught fire.

Fog, blast, and clouds of refrigerated carbon dioxide—refrigeration permits liquefaction and the storage of bigger quantities in limited space—have quenched plane fires so quickly that the planes were saved.

Fog is indispensable in fighting munitions-dump fires. The droplets, evaporating instantly, absorb heat to keep the shells below explosion temperature. If a shell does go off, the job of saving that particular part of the dump is hopeless. Then the fire fighters retire to wait for the inevitable major explosion. And, more often than not, this blows out the fire. It's another kind of "blast effect."

Carbon dioxide gas, in the use of which much pioneering work has been done by Walter Kidde & Co., remains a major fire-fighting agent in industry and in the home. By replacing the oxygen feeding a fire, or by so diluting it that it cannot sustain combustion, the gas kills flames. It is used universally in aircraft-engine nacelles.

Carbon dioxide—or, less often, carbon tetrachloride, another inert gas—is used most commonly on electrical fires. These gases do not conduct electricity, as water and foam do. A conductor, of course, merely spreads an electrical fire over a larger area.

Carbon dioxide has its limitations. It cannot be used on large fires because it cannot be generated in sufficient volume for a sufficient length of time. Wind dissipates it. In closed spaces, it must be handled carefully because, while it will kill fire, it will rob human beings of their oxygen, too.

Fog and foam also have their limitations. Fog seldom works on fires that have got a good start. It can be thrown only a limited distance, much less than a straight stream of water. As yet, no one has been able to generate enough fog to cool a really big fire below the ignition point.

The distance that foam can be thrown also is limited, and on any big fire it must be used in combination with other agents.

Incidentally, the losses from water damage in fires—frequently the greater part of the losses in fires—are cut by fog. It takes less fog to do a job, and fog becomes steam

too fast to allow things to become sodden.

The National Fire Protection Association, organized a half century ago to promote fire prevention, foresees the time when perhaps an ideal combination for industrial fire-quenching of water spray (or fog) and carbon dioxide gas will issue from the same nozzle.

There is room for improvement in fire-fighting. The superlative job being done on the war fronts is not being matched on the home front. Every year from 7,000 to 10,000 lives are lost in fires. Our fire losses in 1944 aggregated more than \$420,000,000, the biggest in U. S. history and up \$100,000,000 from 1942.

Magnet Hangs in Air

A TINY magnet that floats in the air without visible means of support is the latest marvel to be exhibited by Russian scientists and reported by the USSR Academy of Science.

The magnet, a bar of ferro-nickel, remains suspended above a lead plate that has been cooled to 269 degrees below zero centigrade—about four degrees above absolute zero. The explanation is that the electrical resistances of some metals, including lead, drop greatly at very low temperatures. It is believed that the field of the magnet sets up induction currents in the lead and that these repel the magnet.

If thrown on the cold plate, the magnet bounces into the air and hangs there until the temperature of the plate rises about three degrees, when it settles onto the surface.

"Tele-Curve" Copyrighted

"TELE-CURVE," the air map described in the April issue of this magazine ("A Road Map for the Air Age," page 100), is copyrighted by Felix Locher and all rights are reserved.

Invented by Mr. Locher and his son, movie actor Jon Hall, the map shows the air-line distance and shortest flight path to any place on the earth. Separate maps are made for different starting points. Maps are now in print for New York, Chicago, Washington, Los Angeles, San Diego, San Francisco, Panama, Manila, Honolulu, and Tokyo. Others are in preparation.

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Keep your eye on the Infantry... the Doughboy does it! They fight for your postwar future. You save for it. Buy War Bonds!

A WORD on behalf of your dealer. He can't supply you with enough "Eveready" flashlight batteries because of urgent war needs. Nearly our entire production of these dependable, long-service batteries must go to the armed forces and essential war industry.

But your dealer promises you all the "Eveready" batteries you want after victory. And we, in turn, promise that these batteries will be even better than before, even more dependable.



The registered trade-mark "Eveready" distinguishes products of National Carbon Company, Inc.

Tough *but oh so gentle*



● Your automobile *engine* is only as old as its *parts*. Watch for signs of wear, have worn parts replaced promptly, and it will last . . . and *last* . . . and **LAST!**

One of the most important things to watch is the piston rings. Worn-out rings must be replaced promptly, to protect the cylinder

walls and other vital parts.

When your engine shows symptoms of ring wear — smoke, oil-pumping, or loss of power—it will pay you to install Hastings Steel-Vent piston rings. They *stop* oil-pumping, *check* cylinder wear, *restore* performance. Ask your motor specialist.

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HASTINGS STEEL-VENT **PISTON RINGS**



TOUGH ON OIL-PUMPING **GENTLE** ON CYLINDER WALLS

*It's a privilege
to buy War Bonds*

Oven Heats "Sky Plates"

(Continued from page 74)

scale use when the materials are available.

While the plates may be heated in the ordinary kitchen oven, cooking takes 30 to 45 minutes—much longer than in the specially designed Whirlwind oven. Also, the average home oven will not hold as many individual plates, nor can the temperature be accurately controlled, which is necessary for the freshly cooked flavor. The Maxson oven, thermostatically regulated, is equipped with a motor-driven blower which distributes the hot air evenly over both tops and bottoms of the plates.

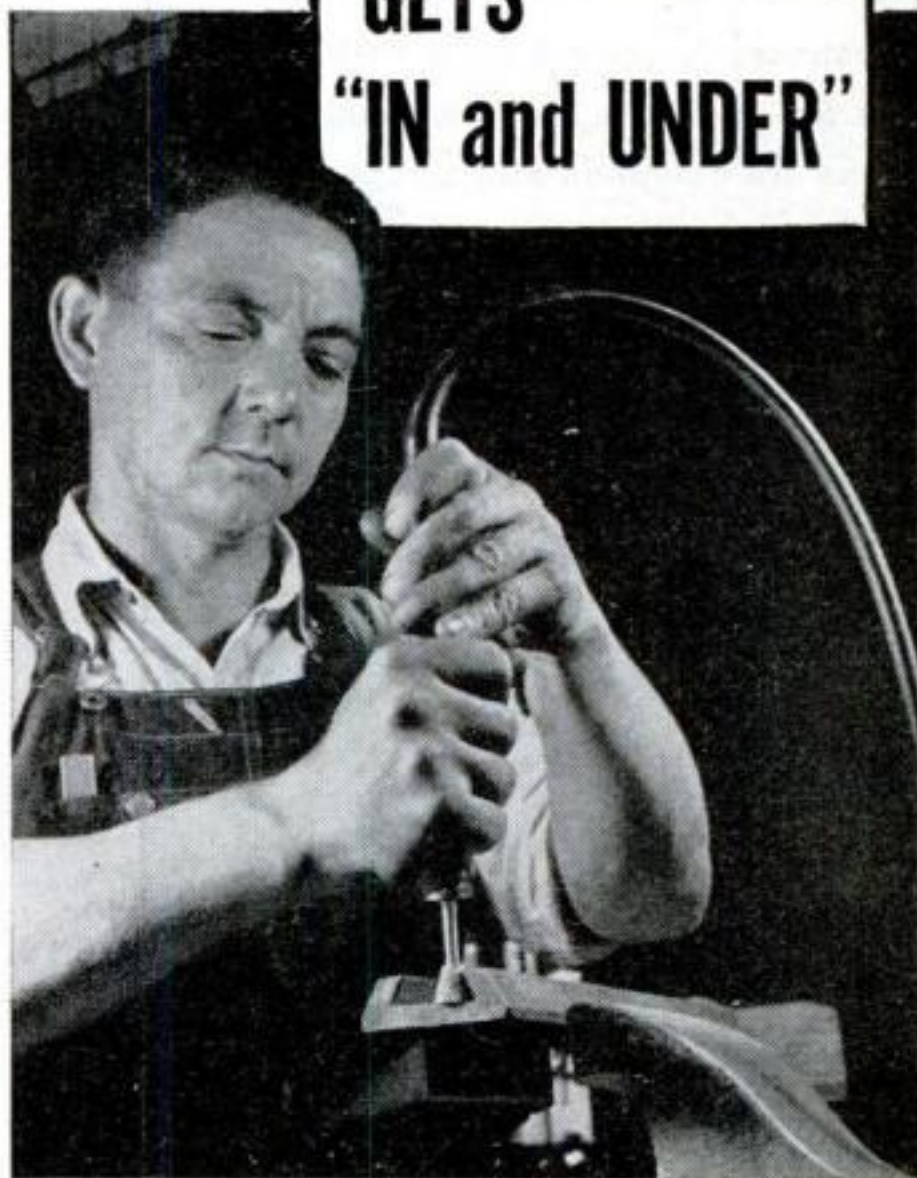
The possibilities of the 15-minute meal are almost endless. The partly cooked food will keep indefinitely so long as it remains frozen. Dishes strange to the American palate could be prepared by chefs on the other side of the world and be served on American tables. At present, the Maxson Food Systems' kitchens are turning out six different menus. These include: (1) steak, buttered peas, and French-fried potatoes; (2) frankfurters and beans with spinach; (3) veal cutlet, home-fried potatoes, and peas; (4) ham steak, candied sweets, and turnips; (5) meat loaf, candied sweet potatoes, and spinach; (6) beef stew, hot bread, and asparagus. In peacetime, the public can look forward to getting such dishes as frozen fowl, fish, corned-beef hash, Welsh rabbit, and many appetizers.

But not everything edible can be put on a Maxson plate. It is impossible to freeze crisp, watery vegetables such as lettuce and celery. They wilt. Bananas turn black. Tomatoes collapse. On the other hand, a savory meal of cold cuts for a summer evening can be prepared. The frozen meat is put in the oven, but no heat is applied. The fan is simply turned on to unfreeze, or defrost, the preparation.

The idea of partly cooking and quick-freezing complete dinners came to Mr. Maxson two years ago when he was wondering what to do with a surplus supply of vegetables he had grown in his home garden in West Orange, N. J. With a home unit he tried freezing almost everything cooked in the kitchen, from French-fried potatoes to soft-boiled eggs. Many months of experiments led to the method by which the units of a complete meal are precooked, assembled, and frozen, and to the invention of the Whirlwind oven.

Now he has a plant a few miles from New York City that, when operating at capacity, is capable of turning out several thousand meals a day, and can store as much as 1,000,000 pounds of frozen food.

GETS "IN and UNDER"



CLEANING or smoothing out hard-to-get-at corners or surfaces is quick and easy with power-driven rotary files. Here, for instance, a Nicholson Inverted Cone Shape Rotary File with *Ground* teeth is used on the "undercut" surfaces of a dovetailed form. (The same shape file is also available with *Hand Cut*, or conventional "file-type," teeth.)

These 16 Nicholson Standard Rotary File Shapes

will serve for practically every kind of job on which a rotary file can be used—breaking and chamfering corners; removing burrs and fins; cleaning, enlarging and elongating holes and slots; working in hollows and acute angles; removing scale:

Ball • Oval • Cone (3 types) • Inverted Cone Cylindrical (2 types) • Cylindrical Double Taper Concave (2 types) • Flame • Barrel • Tree (2 types) • Bi-Shape (Concave-Convex) • CUTS—Coarse, Medium, Fine. DIAMETERS— $\frac{1}{8}$ " to 2".

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ROTARY FILES
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FOR EVERY PURPOSE

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CLEAN SPARK PLUGS SAVE UP TO ONE GALLON OF GAS IN TEN



AC
SPARK
PLUGS

BUY MORE THAN EVER IN THE 7TH WAR BOND DRIVE

Trainer for Jet-Plane Pilots

(Continued from page 85)

from the ship probably would feel as though he had walked into the path of a flame thrower. Fifty feet away he might be knocked from his feet, but he wouldn't get badly burned.

Principal problem of today's jet planes has been fuel consumption—lack of range. Jet engines have been far from economical on take-off or at low speed and altitude. Only at high altitude and speed have they been as economical as conventional airplane engines. The Germans also have had to face this problem, which has limited operational range. But our engineers seem to be well on their way to a solution; official announcement of the P-80 says that it "operates over any of the ranges at which conventional pursuit ships of today are called upon to perform."

Among the pilots who checked out on the P-59 were boys who, flying our conventional fighters, had faced German jet planes over Europe. How does the P-59 compare with the German jet jobs? "I couldn't say," one such pilot replies with a smile. "I never flew one of the German jobs. And they never stuck around long enough for us to study them." In combat, the German jet planes usually operate at extreme speeds, making perhaps one or two passes at a conventional fighter and then getting away from there in a hurry. At such speeds, our pilots generally agree, the German jets are slow in maneuver, and a conventional American fighter plane can side-step them unless the pilot is caught completely by surprise. The German jets traveling 500 m.p.h. or better seem to need about five miles to turn around. Our conventional fighters can turn in about a mile at around 400 m.p.h.

The pilots do indicate, however, that the P-59 at the speed of a conventional fighter—that is, around 400 m.p.h.—probably can outmaneuver the best of the German or Jap conventional fighters. In addition, it has at least the extreme speed of the German jet jobs, with consequent loss of maneuverability.

The future of the jet plane is anybody's guess. You hear all kinds of predictions. Lawrence D. Bell, president of the Bell Aircraft Corp., which built the Airacomet, says: "Within five years no military fighter planes will be built which do not incorporate the jet-propulsion principle. There is no doubt that jet-powered planes will make all present types obsolete in years to come." That opinion is not universal, even

(Continued on page 216)

These scientists are working for you

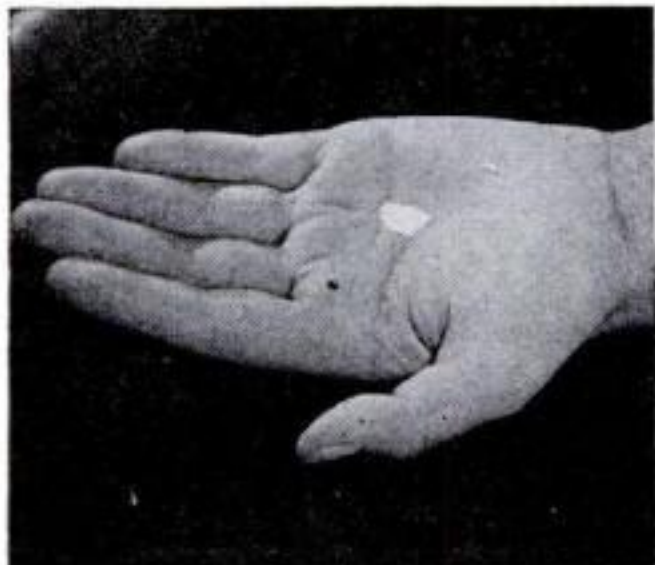
A G-E SCIENTIST, winner of the Nobel prize, studies oil films on water. From this research comes a clue to make glass invisible, metals stronger, to create fog by machine.

Engineers working with certain radio waves run a temperature. A G-E fever machine utilizes this principle, so doctors can treat patients with artificially created fevers.

This page of pictures isn't one-hundredth part of what is going on at G.E. But you will see a few ways in which G-E scientists make life easier, healthier, happier. *General Electric Company, Schenectady, New York.*

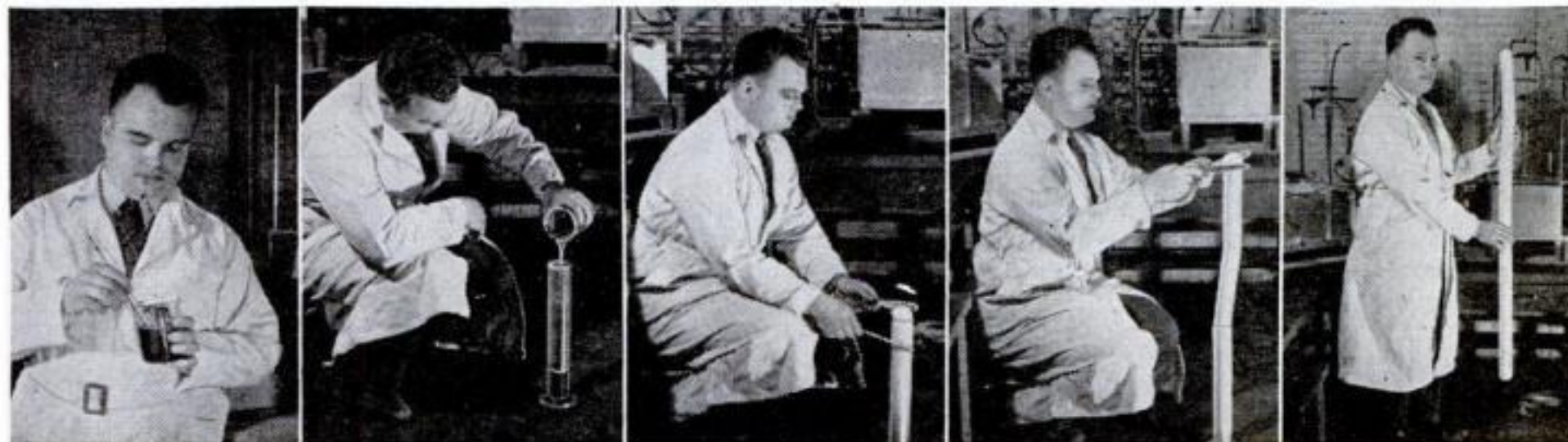
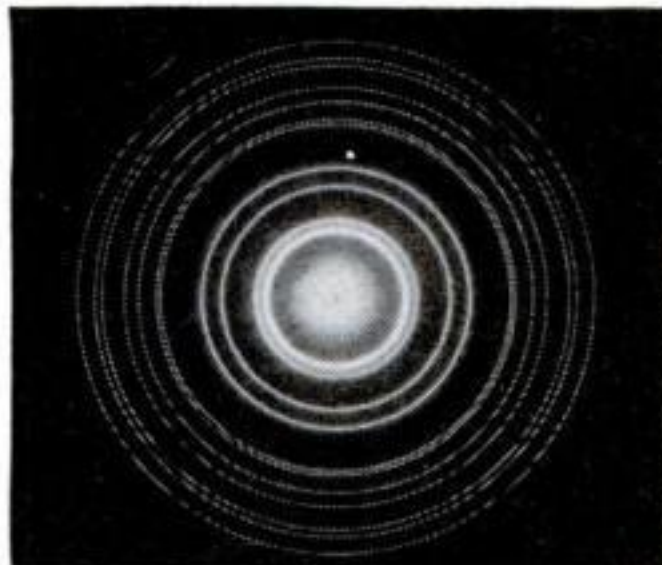


Worst weather in the world is found atop Mt. Washington, N. H., where ice feathers like these sometimes grow three feet in a single night, and where G-E scientists are conducting cold weather research for the Air Forces. General Electric devices are helping the Signal Corps, the Weather Bureau, and the Air Forces predict the weather all over the world. Accurate weather prediction aids troop movements, saves crops, protects you.



Ever see pure vitamins? These three pinches of vitamin crystals in the hand of a G-E scientist are enough carotene, vitamin C, and thiamin for the average man for a day. Research at G-E Consumers Institute helps improve diet, make food taste better.

Picture of gold made by shooting electrons through gold less than a *millionth* of an inch thick was made by G-E scientists in studies to improve metals.



You can actually see it grow. New G-E foam plastic grows at the rate of an inch a second from a liquid re-

sembling molasses. Lighter for its size than a loaf of bread, it promises to have many uses after the war.

★

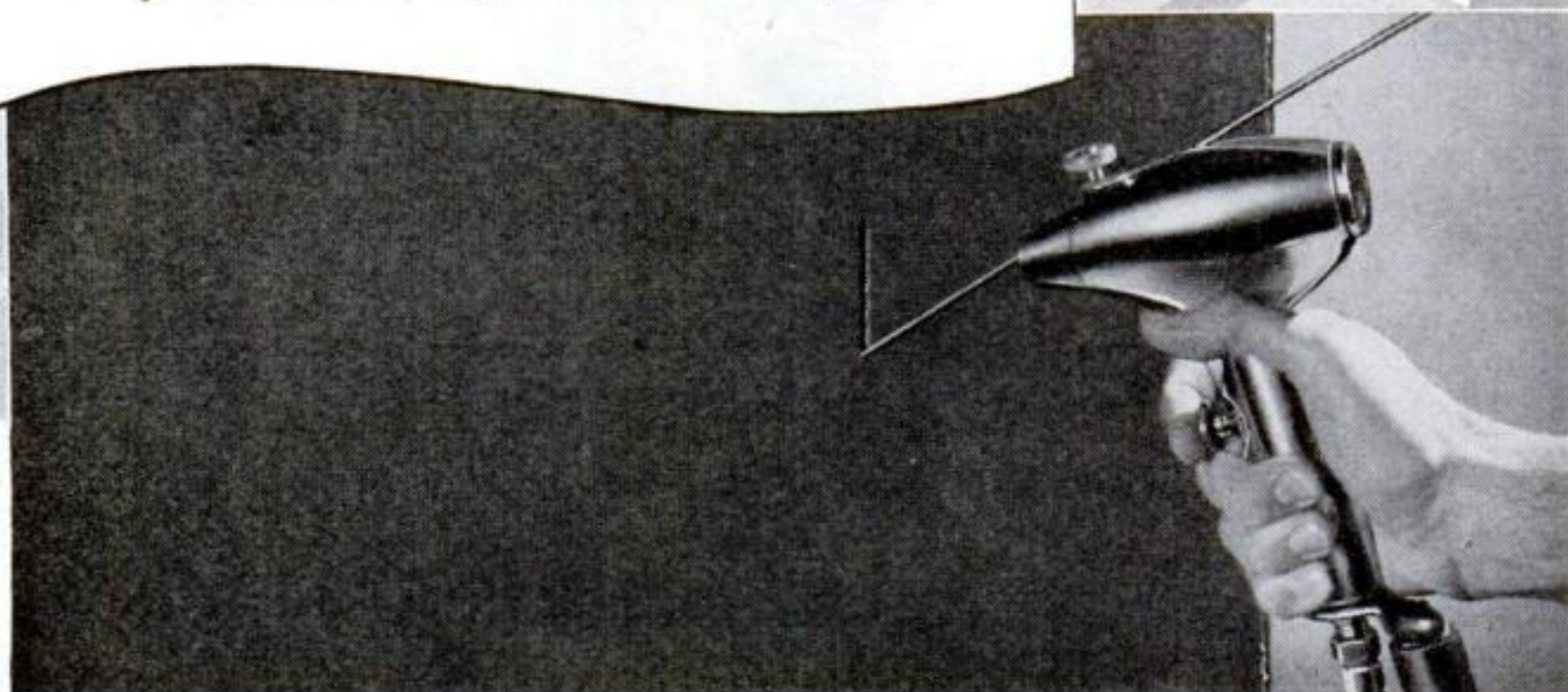
Hear the G-E radio programs: *The G-E All-girl Orchestra*, Sunday 10 p.m. EWT, NBC — *The World Today* news, Monday through Friday 6:45 p.m. EWT, CBS — *The G-E House Party*, Monday through Friday 4:00 p.m. EWT, CBS.

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Ingenious New Technical Methods

Presented in the hope that they will
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Highly Versatile "Pencil Weld Gun" Welds Cold . . . Corrects Flaws and Defects . . . Saves Man Hours, Materials

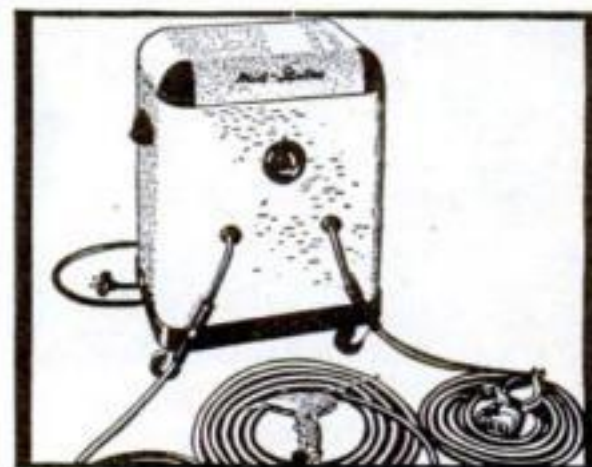
The Pencil Weld Gun, used with its Vibra-Weld Transformer, offers simplicity and versatility never before known in the industry. Equally effective in correcting flaws and defects in both ferrous and non-ferrous metals—for welding cold, without setting up stresses or crystallization.

Simple in operation, the Pencil Weld Gun requires but a few moments' practice to achieve results formerly unobtainable with any method. Utilizing a combination of air, high amperage and low voltage, the weld never exceeds 125° to 130° F. The gun uses a pure aluminum or nickel rod, which is applied directly to the defective area. When the surface has been finished and polished off, it is impossible to detect the repair. Easy to use, as gun peens and welds simultaneously. The Pencil Weld Gun and Vibra-Weld Transformer can be used wherever 220 volt single phase electricity and air outlets are available.

Unavailable, however, is Wrigley's Spearmint Gum. As the makers of Wrigley's Spearmint are unable to continue manufacture of the product up to their quality standards under present conditions, the only unqualified protection they can give to the consumer and the dealer alike is to keep the Wrigley's Spearmint wrapper empty. While they advertise this empty wrapper, none is being made and any found on the market is old production of a perishable product.



Close-up of new Pencil Weld Gun



Pencil Weld Gun with Vibra Weld
Transformer

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The gunsight that "thinks" faster than humans...or Japs!

IN MID-1942, our Navy received its first shipments of a new secret device...

And the next time that Jap pilots attacked one of our ships, they got a mighty unpleasant surprise.

The ship was "Battleship X"—the famous USS *South Dakota*. The surprise was a screen of anti-aircraft fire so deadly accurate that 32 Sons of Heaven were shot down before they could strike.

The device that enabled our anti-aircraft gunners to put up this devastating screen was the Mark 14 Gyro Gunsight.

The Sperry Gyroscope Company—long before Pearl Harbor—had been sponsoring some special Gyroscopic studies in the Instrument Laboratory of the Massachusetts Institute of Technology.

These studies resulted in the development of the Gyroscopic Automatic Computing Sight by Dr. C. S. Draper, director of the Instrument Laboratory of M.I.T.

A successful gyro gunsight was produced. It was first applied to

rapid-firing 20 millimeter guns. And the accurate screen of protective fire that it enabled our gunners to put up made it almost suicidal for enemy dive bombers and torpedo planes to approach within range.

Keeping ahead of the Nips

This forced the enemy to improve his attack planes so his pilots could launch their missiles out of range of 20 millimeter guns. So a gun director was developed which, by remote control, utilized the Gyro Gunsight to aim 40 millimeter twin and quad mounts, and even larger caliber guns.

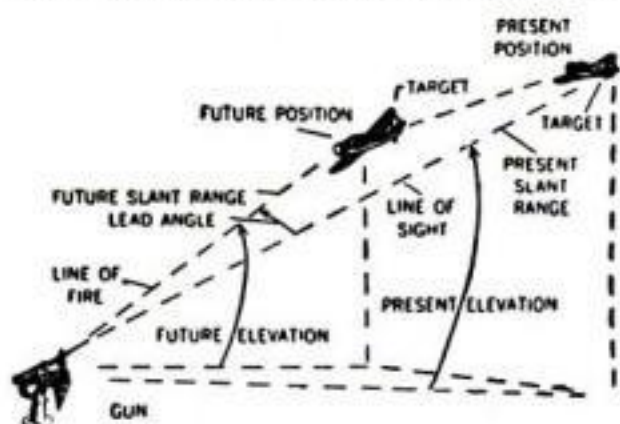
Now American ships could reach out and blast enemy planes even

before they could go into their attack runs.

In fact, our ships were able to operate within range of land-based bombers and torpedo planes.

Using the Gyro Gunsight, the gunner sees his fast-moving target through an illuminated ring. As he keeps the target within the sight, the gun automatically leads the target, compensating for movement of the plane during the time of flight of the projectiles.

Thus, the guesswork was taken out of anti-aircraft gunnery, and thousands of enemy pilots were sent to Davy Jones' locker.

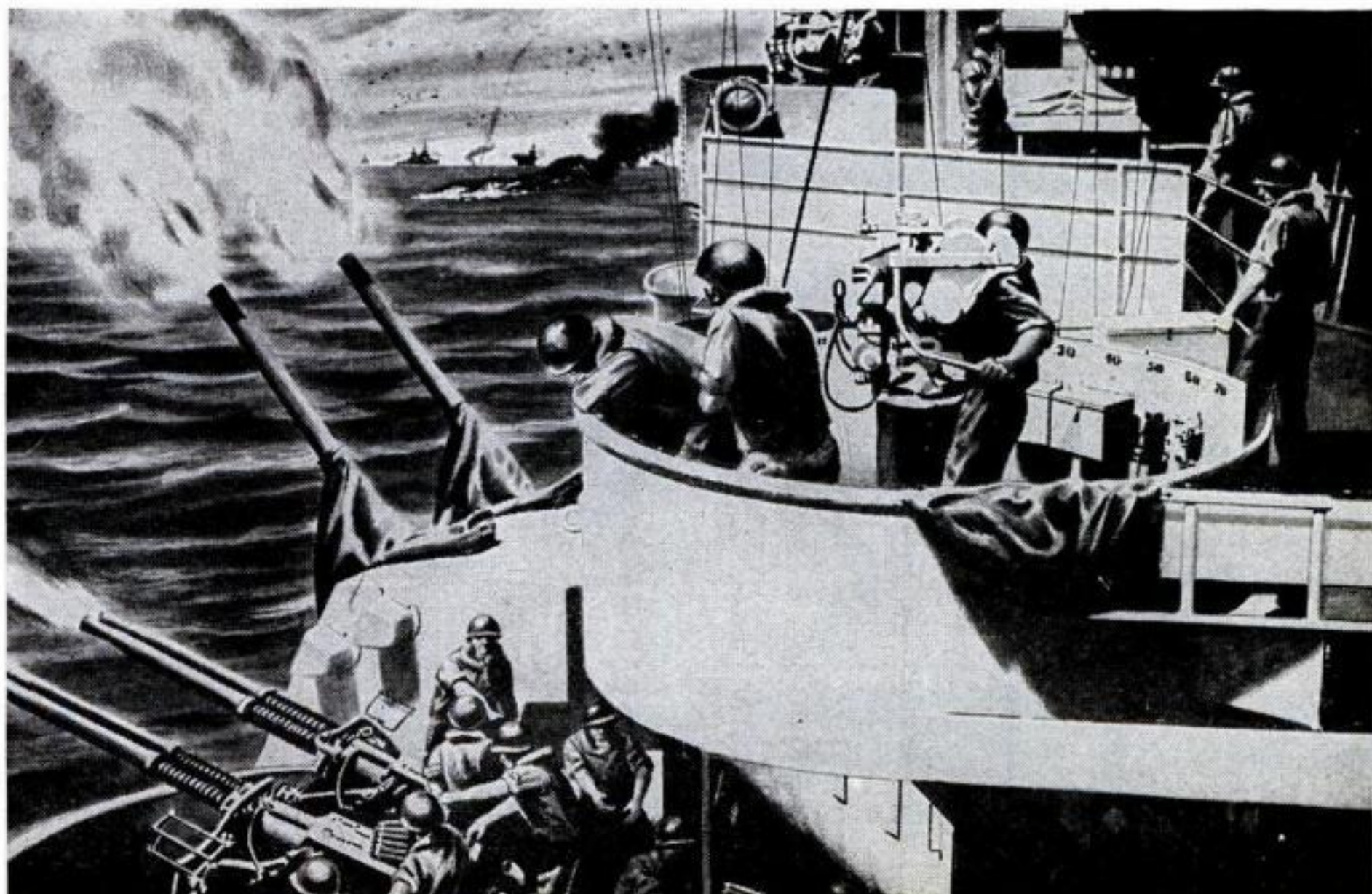


SPERRY

CORPORATION

30 Rockefeller Plaza, New York 20

FORD INSTRUMENT CO., INC.
SPERRY GYROSCOPE CO., INC.
VICKERS INCORPORATED
Waterbury Tool Division,
VICKERS INC.





Now car polishing is QUICK and EASY

DU PONT No. 7 POLISH



Makes your old car look like new

Don't put off the job any longer. It is easy to make that old dull finish sparkle like new—and it takes very little time. Try No. 7 Polish—there's nothing quicker or easier to use.

Clean rust and scale out of your radiator

Avoid radiator troubles and expensive repairs by using DuPont's Cleanser now. It removes rust, scale and grease thoroughly and quickly without harming the hose, packing or metal parts.

DU PONT
Cooling System Cleanser



BETTER THINGS FOR BETTER LIVING... THROUGH CHEMISTRY

Trainer for Jet-Plane Pilots

(Continued from page 212)

among those who have worked a good deal with the jets. But there is no doubt that the jet plane is already opening a new horizon in flying.

Right now one can sum up the advantages of the jet plane in this way:

It has more speed and a higher ceiling than the conventionally powered ship.

It has less weight per horsepower at altitudes of equal operating efficiency.

It has considerably fewer working parts, which means less danger of breakdown; it also means simplified maintenance.

A practical pilot, with plenty of hours over enemy territory and a respectable number of enemy kills to his credit, sums it up this way:

"The jet is fast as all hell. It can outclimb anything else I've ever seen. It can outmaneuver most of them at their own speeds. It would be a honey for strafing, or for attacking bombers, or probably for dog-fighting, though today you usually make a couple of swift passes and get him or get the hell out. It's a thoroughly sweet ship. But I'd like to know what happens to her when she takes a piece of flak or a few .50's through those windmill furnaces of hers. Maybe I'm jittery, but I know how the ships I've been flying over there—the propeller ships—act when that happens. I know how much they'll take and still bring me back. When I know as much about the jet jobs, then I can speak with authority. Meanwhile, she's one sweet ship to fly. Ain't had so much fun since I was a kid in high school."

Waste paper is a war weapon. Save every scrap of it for the knockout in the Pacific.



Model Builders Attention!

	V	V-2	V-3
Hex	1/2"	3/8"	5/16"
Thread	3/8"-24	1/4"-32	1/4"-32
Thread Length	7/32	7/32	5/32
Weight, Grams	8	3 1/2	2 1/2

Actual Size V-Plug

Champion spark plugs for model gas engines give the same dependable performance as regular Champions. Silliment sealed. Sillimanite insulator. Alloy needlepoint electrodes for easy starting. One piece construction.

CHAMPION

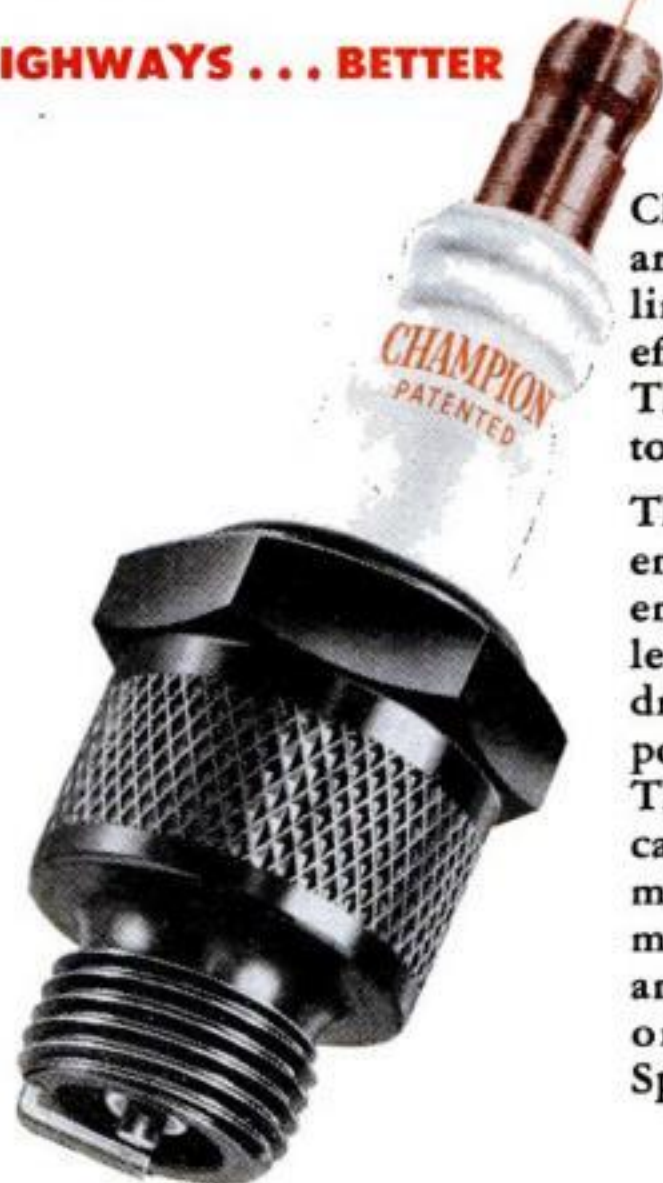
SPARK PLUG COMPANY • TOLEDO 1, OHIO



FROM THE SKYWAYS...

TO THE HIGHWAYS... BETTER

SPARK PLUGS FOR YOUR CAR



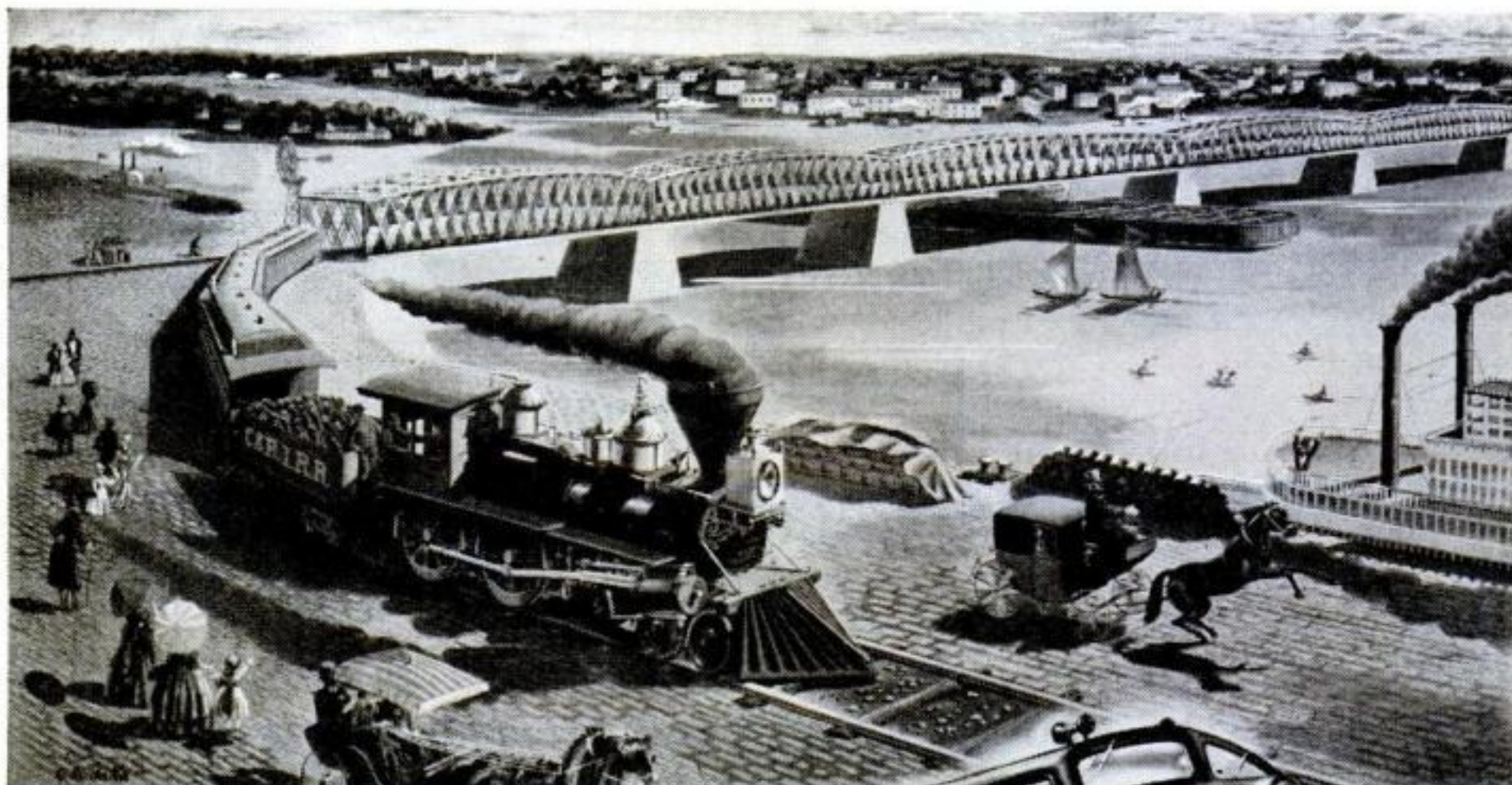
Champion Ceramic Aircraft Spark Plugs are used exclusively by National Airlines because "they are dependable, efficient and completely satisfactory." They strongly emphasize maintenance to insure dependability.

Thus once again the prestige and efficiency of Champion Spark Plugs for every engine is confirmed by their use by a leading airline—just as it has been so dramatically demonstrated in the most powerful bombers and combat planes. The Champions you buy for your present car benefit from the same research, basic materials, engineering and precision manufacture. Naturally they will insure an extra measure of performance, economy and dependability. Champion Spark Plug Company, Toledo 1, Ohio.

DEPENDABLE
CHAMPION
SPARK PLUGS



Buy Bonds
"Bigger Bonds for
the Mighty Seventh"



October 10, 1852, the famous Rock Island steam train, the "Rocket," made its initial trip between Chicago and Joliet, Ill. Several years later the Rock Island Lines opened the first bridge across the Mississippi. With true poetic license, the artist has brought these two events together.



The Rock Island Lines operate a fleet of fast and powerful General Motors Diesel freight locomotives known as the "Hercules." They are fitting railmates indeed to the General Motors Diesels which power the new and modern Rock Island "Rockets" of today.

GREAT THINGS ARE HAPPENING IN TRANSPORTATION

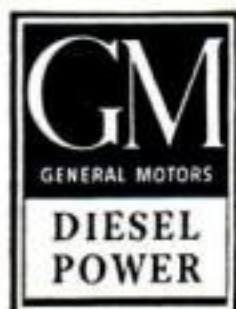
When people discuss travel you'll often hear mention of the big, powerful Diesel locomotives that are hauling so many of America's crack trains.

You may, or may not, know that by far the greater number of these new and modern locomotives are built by General Motors. Railroad men know it. And they will tell you, too, how these amazing GM Diesels have changed all previous ideas of speed with

comfort and safety for passengers; how they have effected economies and efficiencies beyond all previous railroad experience.

It may be your good fortune to ride behind one of these passenger Diesels on your next railroad trip. Or, perhaps you have seen one of these powerful freight locomotives pulling a mile-long loaded train. If so, you'll know why it's a great new day for railroading—with even greater days to come.

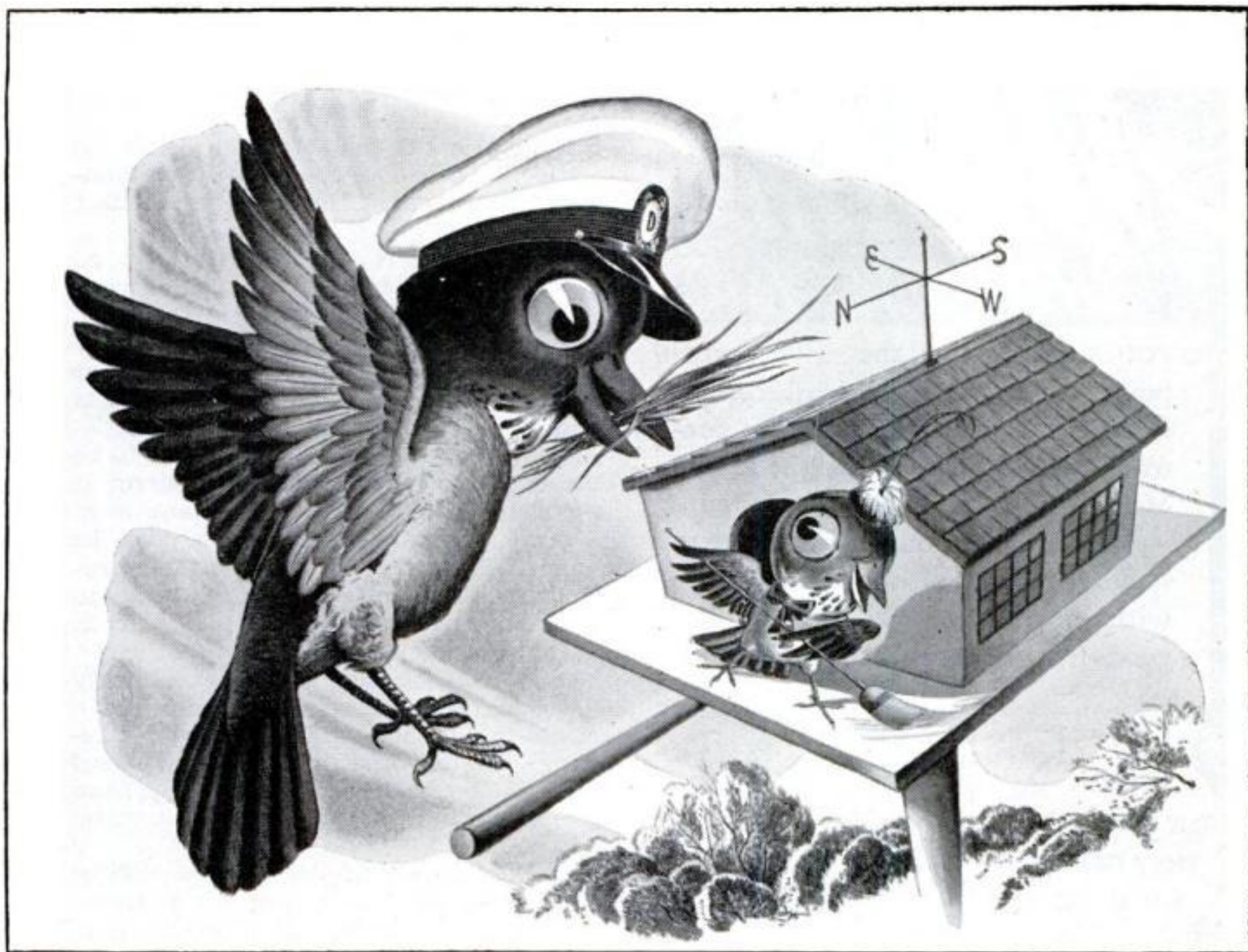
ON TO FINAL VICTORY
BUY MORE WAR BONDS



LOCOMOTIVES ELECTRO-MOTIVE DIVISION, La Grange, Ill.

ENGINES . . 150 to 2000 H.P. . . CLEVELAND DIESEL ENGINE DIVISION, Cleveland 11, Ohio

ENGINES . . 15 to 250 H.P. . . . DETROIT DIESEL ENGINE DIVISION, Detroit 23, Mich.



It's Homemaking Time Again

THIS little home-building, feathered fellow with his jaunty Defoe yachting cap and his pretty mate symbolize what thousands of American families would be doing about now if this were a normal, peaceful spring.

● ● Perhaps next spring will be—and *you* will be building a new home. In the meantime, you can keep adding to your nest-egg of War Bonds which will help finance it. And we at Defoe can plan ahead for the surprising and thrilling things we will be able to build into it for you.

● ● Of course, Defoe's engineering experience and production facilities are now

being used only to build more warships and badly needed cargo ships for the Navy. However, the postwar plans of our Housing Division are progressing. New methods of manufacture are being worked out and a host of building materials put through a series of exhaustive tests to make certain that the new Defoe homes will set the pace for living comfort, efficient functional design, beauty and individuality of exterior treatment.

● ● Follow the story of Defoe's little home-making birds in subsequent advertisements and let them lead you to eye-opening developments in a new concept of housing for Americans.

HOUSING DIVISION—DEFOE SHIPBUILDING CO.,

BAY CITY, MICHIGAN

BACK THE ATTACK
—BUY WAR BONDS

Defoe

SHIPS FOR VICTORY
SERVANTS FOR PEACE

☆☆☆☆ Five White Star Renewal Citations now decorate the Navy "E" Award won by Defoe workers.

The Best Marlin RIFLES SINCE 1870

● TOOLS ARE READY, the skilled manpower is ready to make Marlin sporting rifles again as soon as war contracts permit. They will be the best in Marlin's 75-year history. Honest guns—safe, accurate, long-lived. Built to standards that made the name famous, with war-improved skills. Now is a good time to look over the Marlin line

WATCH
THE INFANTRY
THEY CARRY
THE GUNS

OTHER MARLIN .22 RIFLES

**MODEL 81-DL BOLT ACTION
.22 CALIBER REPEATER**
Dependable patented magazine
feeder. Automatic side ejection. 25
shots for vermin and small game.

★
**MODEL 80-DL CLIP MAGAZINE
.22 REPEATER**
8 fast shots for small game. Among rifles
recommended for target practice by
N. R. A. Man-sized gun at a low price.

★
**MODEL A1-DL AUTOMATIC
.22 CALIBER RIFLE**
6 shots as fast as you can pull the trigger.
Ideal for fast-moving small game, vermin.

Illustrated

MODEL 39-A

By many considered
the world's best all-
around light rifle, .22
cal., lever action, 25
shots.



THE Marlin
FIREARMS COMPANY
New Haven, Conn.

The Norden Bombsight

(Continued from page 73)

But how is the line of sight held? In other words, how does the mechanism maintain the illusion that the plane is standing still?

This neat trick is done with a mirror no bigger than the face of a man's wrist watch. The bombardier looks straight down, but this mirror is suspended beneath the lower end of his telescope, and tilted so that the images he sees in it are those of objects far ahead of him.

As the plane approaches the object to be bombed, the angle at which this mirror is hung changes. The closer the plane is to the target, the faster this angle must be changed. The mirror's motion is synchronized with the plane's motion, however, in such a way that the image of the target is held in the center of the sight.

This synchronization is an exceedingly delicate business. The mirror is moved by a variable-speed drive. This consists of a revolving disk, against which a tiny wheel is placed. The farther the wheel is set from the center of that disk, the faster the wheel goes around.

The rate at which the disk should be turning is determined before the bombing run begins. The bombardier notes the speed and altitude of his plane, the temperature and the barometric pressure, then consults a book of mathematical tables. Its figures are printed in luminescent white on black paper, so that he can see them in dim light. From this book of tables, he finds the approximate speed at which the disk within his sight should be turning to synchronize the movement of the mirror with the plane's speed at his altitude.

He then sets the "disk speed" dial on the instrument, and checks the speed of the disk twice by plugging in a tachometer that he carries in his pocket. Even so, when the bombing run begins, the mirror will not be closely enough in step with the airplane. So he will make final adjustments then to perfect this synchronization.

Meanwhile, the bombardier looks up another number in his book of tables and sets a "trail arm" on the bombsight. This gives the computing mechanism the ballistic data it will need. But this mathematical information, too, may be changed slightly by adjustments that the bombardier will make only a few seconds before the bomb is dropped.

All these pains to attain precision would be futile, and the bombardier's view of his

(Continued on page 224)



New 1945 Link Trainer, not only teaches instrument flying but, according to pilots, "flies more like an airplane than an airplane does!"

Mission Completed, Plane Safely Home!

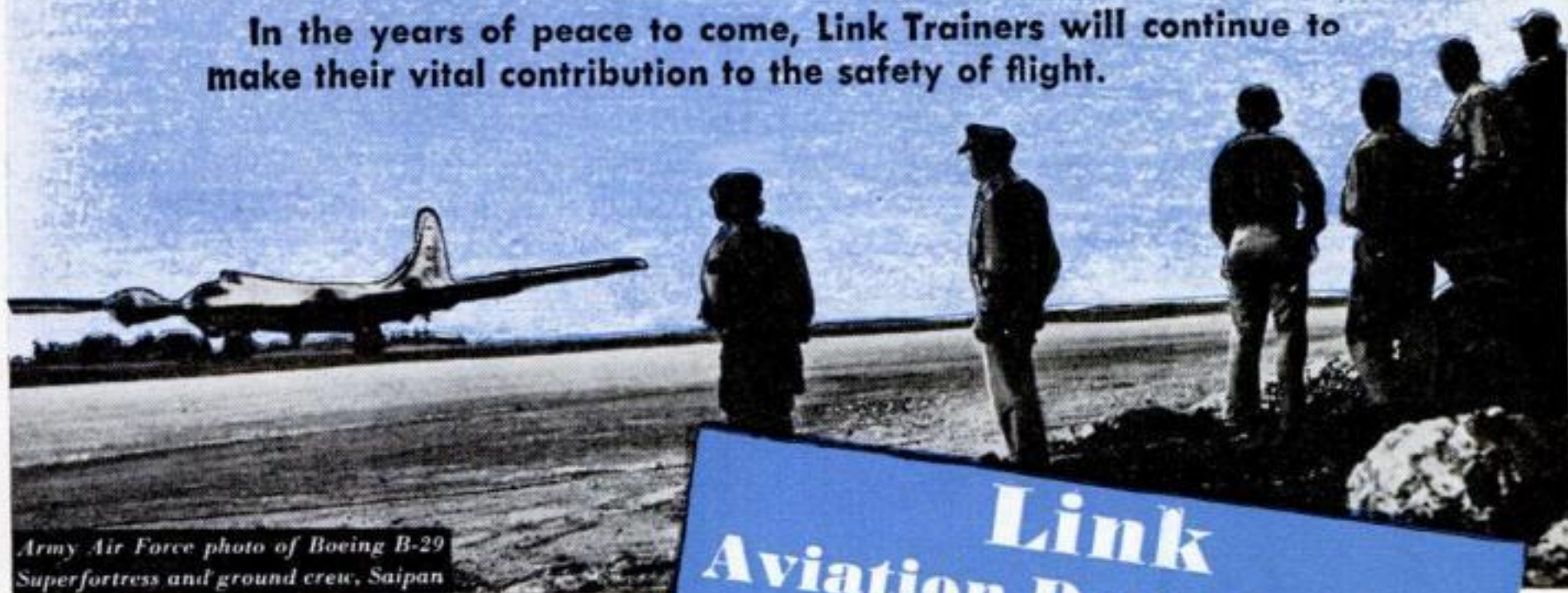
To the ground crew sweating it out for the bomber's return, to the Air Force Commander and the folks back home, there are no words so thrilling as "plane returned safely."

In this short phrase are condensed all the months of arduous pilot training...all the ingenuity of engineer and skill of aircraft worker...all the devotion and know-how which have invested with maximum safety the fine and scientific art of flight.

Safety in flight is the solid base upon which our vast air force operations are built. It is the reason-why of Link training for all air force pilots. In the Link, our pilots learn to cope with emergencies of darkness and weather, to fly safely and surely by instruments alone.

Millions of costly hours of flying time in training planes have been saved by instrument instruction in the Link on the ground. Millions of gallons of precious aviation fuel have been conserved for combat missions. And most important of all—because there are no casualties in the Link—the lives of many, many of America's sons have been saved.

In the years of peace to come, Link Trainers will continue to make their vital contribution to the safety of flight.



Army Air Force photo of Boeing B-29 Superfortress and ground crew, Saipan

Link
Aviation Devices, Inc.
BINGHAMTON, NEW YORK, U. S. A.

LINK MANUFACTURING COMPANY, LTD.
GANANOQUE, ONTARIO, CANADA

Makers of Link Trainers, Crew Navigation Trainers and other Devices contributing to the safety of flight

Good Taste

THAT JUSTIFIES
YOUR CHOICE!



BLATZ BREWING CO., MILWAUKEE, WIS.

In Our 94th Year



*BUY...Don't Sell
War Bonds*

Fast Becoming America's Favorite



UNTIL THE WHOLE JOB IS DONE

It takes ships and planes and guns and men . . . and millions of items of precision equipment, not one of which must fail.

It needs precision *optical equipment* . . . eyes that seek out the enemy, find him, range him, help to destroy him.

This need, for all operations in this war, is still tremendous. Universal Camera Corporation, furnishing such instruments for the armed forces continuously since Pearl Harbor, now

makes binoculars in quantities hitherto thought impossible, as well as other vitally important high-precision optical instruments.

Universal will continue to devote its efforts and facilities wholeheartedly to the manufacture of these instruments as long as needed. But when the war job is done, the production of hundreds of new Universal Cameras, Photographic and Home Movie Equipment items will begin immediately.



UNIVERSAL CAMERA CORPORATION

NEW YORK • CHICAGO • HOLLYWOOD

Wartime Manufacturers of Precision Instruments for the Armed Forces
Peacetime Manufacturers of Mercury • Cinémaster • Corsair Cameras and Photographic Equipment

UNIVERSAL CAMERA CORPORATION'S WAR RECORD

1941 . . . Started War Work
(before Pearl Harbor)

1942 . . . Over 80% Essential War Work

1943 . . . Over 99% Essential War Work (Army-Navy "E" March 13)

1944 . . . Over 99% Essential War Work

TODAY . . . Over 99% of our facilities are devoted to producing essential precision instruments for the Armed Forces, and will continue to be while the need exists.

You'll still have to wait for the wonderful new photo and home movie equipment we promised you

SLUDGE and GUM



DESTROY ENGINES!



Technicians call them petroleum residues but their everyday names are just sludge and gum. No matter what you call them, they reduce power and shorten engine life. Now that motors are irreplaceable, more and more thousands of owners are protecting theirs with **LOOSITE** and **SILOO**.

The **LOOSITE-SILOO** treatment is speedy, safe, sure and economical. It has been tested and proven through fifteen years of service on passenger cars, trucks, tractors, boats—in fact all types of gasoline and diesel engines.

Ask your serviceman to show you how **LOOSITE** first cleans out the engine then **SILOO** added to fresh crankcase oil keeps it clean. It's the one way to be sure that sludge and gum are not destroying *your* motor.

If you heat with oil — write for information on
SILOO FUEL OIL TANK SOLVENT.

PETROLEUM SOLVENTS CORPORATION
331 Madison Avenue, New York 17, N. Y.

The Norden Bombsight

(Continued from page 220)

target might not be steady enough, if the bombsight were allowed to pitch, roll, and yaw with the plane carrying it. "Pitching" means tossing forward and backward like a bucking horse; "rolling" means leaning first to one side, then to the other; and "yawing" is wavering in direction, like a compass needle on an unsteady pivot. An airplane may indulge in any or all of these three different kinds of undesirable motion at any time.

Pitching and rolling are vertical motions, and these are compensated for by a gyroscope within the sight. Yawing is horizontal motion, and it is compensated for by another gyroscope in the base on which the bombsight stands. These gyroscopes have the same ability to hold a given position that a child's top spinning on the floor of the airplane would have.

To be sure that the bombsight is level, the bombardier looks through a glass plate at two little bubbles like that in a carpenter's level. If necessary, he turns two thumbscrews until those bubbles are in the proper places. There is also an indicator in the base of the sight, which tells him whether the plane is headed the same way that the sight is pointed.

A bombardier who notes these and other details, sets the sight properly, and then adjusts it skillfully during the last lap of the race to the target, does not have to worry about the "course" problem. The automatic pilot flies the plane along a line from which a bomb can be dropped to hit that target.

But the bombsight must also solve the "range" problem; that is, it must decide when to drop the bomb.

It cannot wait until the plane is directly over the target, because the bomb will not fall straight down like a sandbag dropped from a hayloft. When first freed from the plane, the bomb will be moving forward as fast as the plane. Its forward momentum will diminish, however, as it passes through the air, and gravity, at the same time, will increase its downward momentum. The bomb will curve, therefore, in its journey from the plane to the earth.

How much it will curve under given conditions can be foretold mathematically. The bombardier obtained such a forecast from his book, and his adjustments during the bombing run revise this prediction to conform to variations in the conditions.

Thus, the robot is literally told the point
(Continued on page 228)



If Junior breaks your spectacles,
(The frame part, not the glass)
A twist of Texcel temporarily
Mends 'em up first class.

(Texcel mends securely - the "stickum's" bonded on!)

And when you put shelf paper down
And want it anchored there,
Some Texcel Tape, in place of tacks,
Will help prevent a tear.

(Texcel means no gummy edges - the "stickum's" bonded on!)



For sealing clothes in mothproof bags
For mending Baby's book -
For everyone it's Texcel Tape,
From Grampa down to Cook.

(Texcel holds and holds - the "stickum's" bonded on!)

Yes, Texcel is an improved tape
Whose "stickum's" bonded on!
It won't come off, it won't dry out,
It's one, like grass and lawn.



Today, most Texcel Tape that's made
Is being used for war,
Buy Bonds and Stamps till Victory
Returns it to your store.

Texcel Tape

REG. U. S. PAT. OFF.

CELLOPHANE TAPE - STICKS WITH A TOUCH

INDUSTRIAL TAPE
CORPORATION
A Subsidiary of
Johnson & Johnson
New Brunswick, N.J.



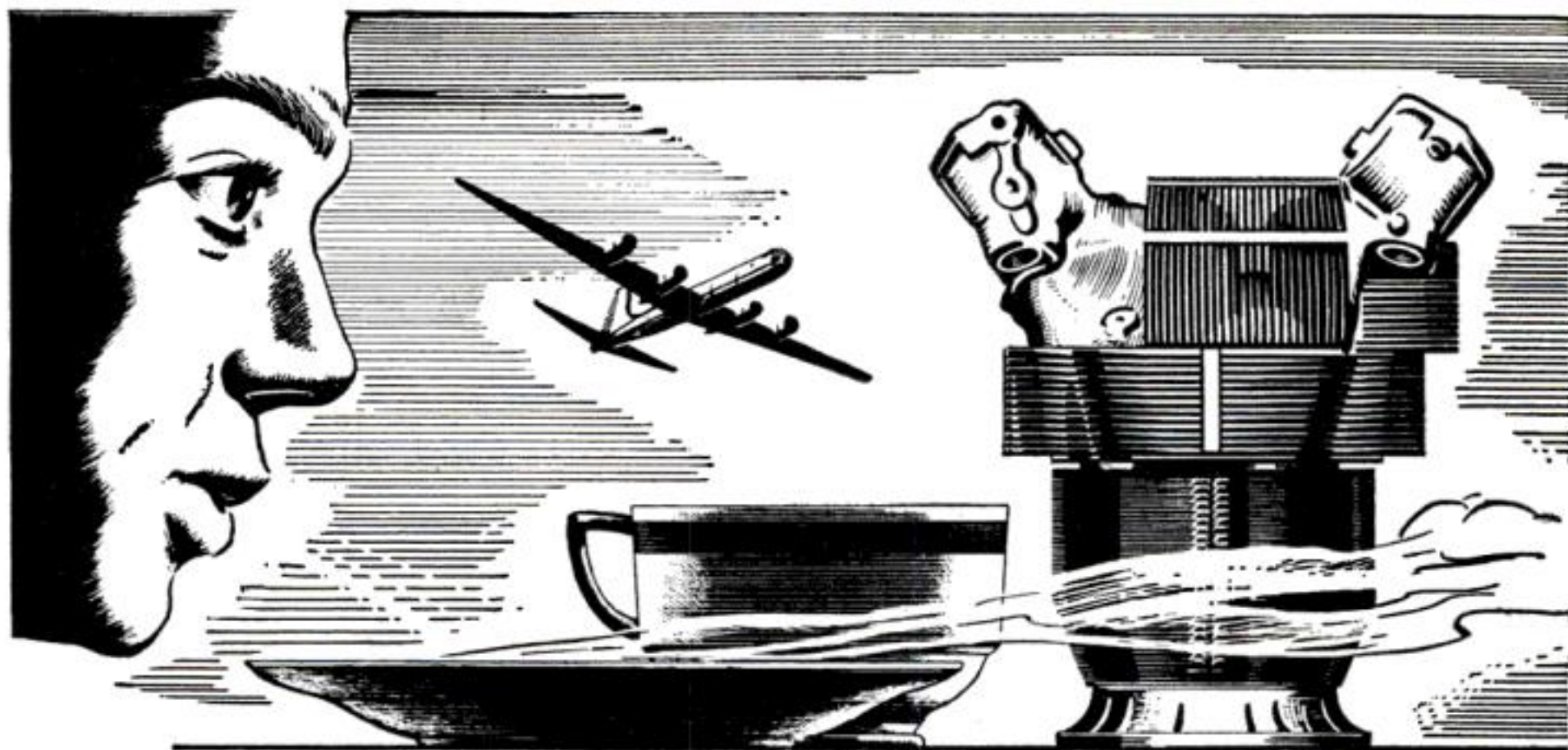
WHEN IT'S AN EXIDE
... you start

Customer-satisfaction comes first with the dealer in business to stay. You get more for your dollar in service or merchandise if you buy where KNOWN brands of products are featured.

THE ELECTRIC STORAGE BATTERY COMPANY Phila. 32
Exide Batteries of Canada, Limited, Toronto

BUY TO LAST

Our armed forces need more and more batteries. Therefore, it is a patriotic duty to give your battery good care. Let your Exide dealer check it regularly and recharge it when necessary. The Pledge Certificate which he displays is your assurance that he will do his utmost to prolong the life of your battery, thereby conserving critical materials and manpower.



COFFEE OR AIRCRAFT ENGINES... AIR Cools More Efficiently

It's scientifically more efficient, if not socially correct, to cool your coffee by blowing on it in a saucer. With a broad exposed surface, it cools faster than in the small area of the cup. Likewise, in a Wright Cyclone engine, the many fins on cylinder heads and barrels mean more area exposed to the air to carry away heat.

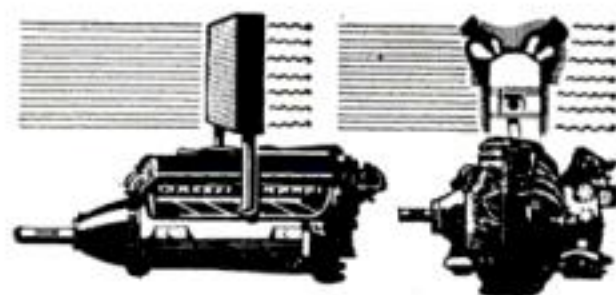
More fuel per cylinder means more power, but it also means more heat to remove. Thus, increases in aircraft engine power have depended on more efficient cooling. Wright Aeronautical engineering of cooling fins has made possible the Cyclones which now develop as much as 150 HP per cylinder and still run cool.

SEND FOR "ENGINELOGY"
only 25¢

100 pages of Engine Information

Learn more about aviation's source of power. Engineology explains supercharging, combustion and engine principles in non-technical terms; describes their relation to planes and propellers. Just send 25 cents in U.S. coin to:

Wright Aeronautical Corporation
Dept. PS, Paterson 3, New Jersey



WATER VS. AIR: An engine can be cooled with a water jacket and radiator, but air still has to cool the water. Cyclone cylinders eliminate water, plumbing, radiators and leaks, and keep engines cool by fins on cylinder heads and barrels.



FIN AREA ADDS UP: Fin area on a single Wright Cyclone cylinder is nearly 30 sq. ft. This is 540 sq. ft. per engine. On the four Cyclones of a Boeing B-29 there is more fin area than the total wing and tail area of the plane.

WRIGHT

AIRCRAFT ENGINES

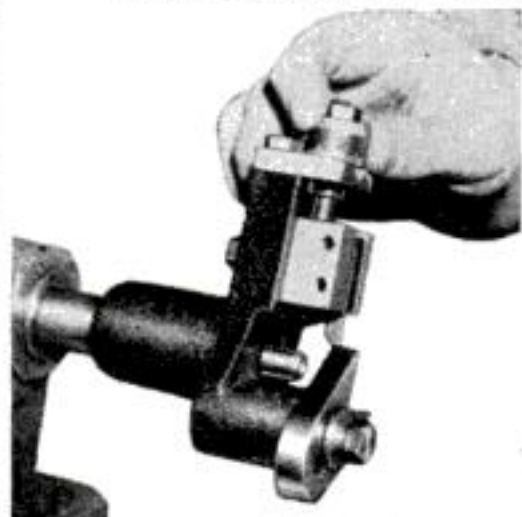
DIVISION OF

CURTISS  WRIGHT

FIRST IN FLIGHT

NEW LATHE ACCESSORIES

For the toolmaker-machinist, Home Craftsman, or Production Shop



TAILSTOCK TURNING TOOL

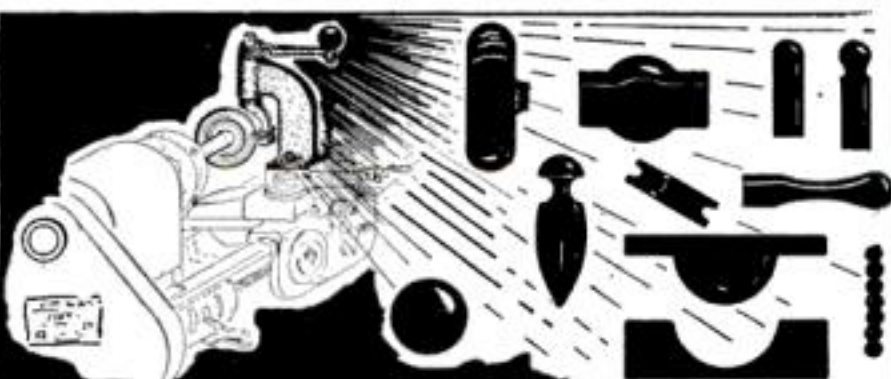
complete \$18⁷⁵
(fits any lathe)

Turn accurate sizes to precise lengths and perfect finish—easily and quickly—as simply as drilling a hole! Slashes machine time 1/3 on occasional jobs—Ten times as fast on production work.

"Set to size and feed the tool—it does the rest"

This new precision "box" tool is fitted to the tailstock (or in the turret) of any lathe. The back rest is quickly set to any stock diameter up to 3/4". The micrometer dial is set to the desired size, the length stop to the required length—that is all that is necessary to produce one or thousands of pieces, accurate, concentric and with fine finish, in one cut. Stock can be reduced to any size, maximum length turned can be up to 4 1/2". Uses regular 1/4" lathe tool bits. Furnished complete with removable #2 taper shank, and can be mounted on straight shank for turrets, has 5/8" hole for mounting. Sleeves make it possible to fit any lathe taper. Complete instructions furnished.

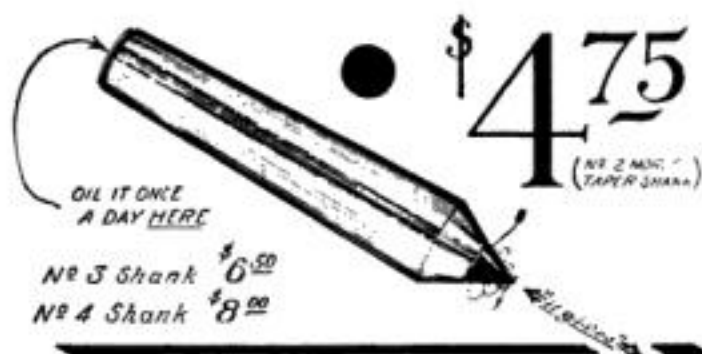
RADIUS AND SPHERICAL TURNING ATTACHMENT Only \$17⁵⁰



Turn precision concave or convex radii, spheres, etc., simply as straight cuts, with this new low cost quality tool

Here is what thousands have been waiting for! This unique attachment fitting all lathes will turn any of the shapes shown above and many more. Work such as spherical bearings and seats, balls, dies & forming cutters, handles, pulleys, hand-wheels, etc., etc. Tool is mounted quickly as a tool holder, it may be set with scale or micrometer. Handles work up to 4" diameter. Uses regular 1/4" tool bits, on wood or metal. Fits all small lathes to 11" swing, for larger machines mention make and size and add \$2 for adapter. Get yours now! Everyone who has seen and used this tool is enthusiastic!

REVOLVING TIP LATHE CENTER



Banish lathe center worries forever! This famous, simple "live" center now available to all—thousands sold. Revolving spindle permits tip to turn with work, special construction permits it to yield and compensate for work expansion. Fitted with adjustable ball thrust bearing. Hardened tool steel parts. A time and money saver. If you don't have one of these centers you're missing something—we guarantee you will never use old-style centers again.

We are able to offer immediate shipment from stock of any of the above items. Shipments made prepaid if remittance accompanies order. We ship C.O.D. upon receipt of deposit. All tools fully guaranteed, try ten days and return for instant refund if not satisfied.

THE SMITH TOOL & SUPPLY CO.
889 SOUTH FIRST ST. SAN JOSE, CALIFORNIA

The Norden Bombsight

(Continued from page 224)

at which the bomb should be released. But how does it know when the plane has reached that point?

The bombsight finds this out by measuring the speed with which the angle between two lines changes. They are invisible lines, possibly extending for many miles. One line is down the center of the bombardier's telescope, from his eye to a point directly below him on the earth. No matter where the plane is, or how it pitches, rolls, or yaws, that line remains straighter than a flagpole because the sight is gyro-stabilized. And the other line is your old friend, the constant line of sight—maintained by the tiny mirror—between the Norden apparatus and the target.

When the target is first seen, the angle between these lines may be 70 degrees. It becomes narrower as the airplane moves closer to the target. And the bombsight notes how fast the angle is diminishing.

This mathematical information, plus the data already in the bombsight, gives the mechanism the answer to the range problem. The instant the plane passes through the point in the sky from which the bomb's ballistic curve will carry it to the target, a switch clicks and the bomb is launched.

In a slot on top of the bombsight, there are two tiny contact points. The bombardier never touches them, but they show him what is happening. One indicates the bombsight's forecast of the point along the plane's path at which the plane should let go of the bomb. The other indicates the airplane's progress along that path. Hence, this second contact point creeps toward the first one during the bombing run. When they meet, the bomb switch is thrown.

The mechanism can be set so that one or several bombs will be dropped. As each one leaves the bomb bay, a tiny light on the bombardier's instrument panel goes off, and when the first light blinks out the bombardier shouts "Bombs away!"

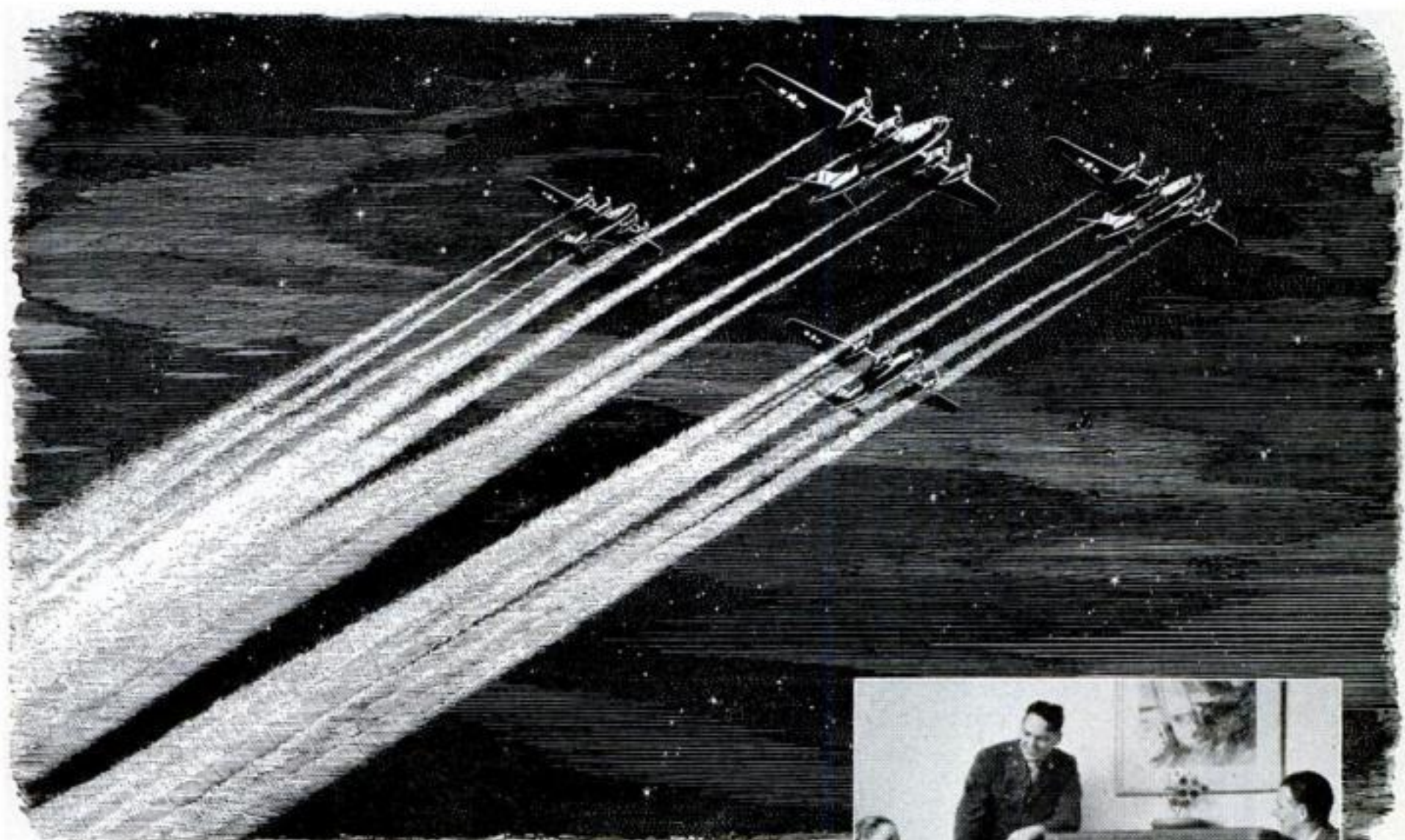
The Norden sight's accuracy depends wholly on the bombardier's ability to set it properly. Crouched in the nose of a plane, he may see a Jap factory on the horizon. He points at it with his hand, squints down his nose, and turns his \$6,000 bombsight in that direction. He makes sure the sight is ready for action, then bends forward and locates the target through his telescope.

Two fixed hairlines cross his field of vision. He spins a knob until the image of the factory stays under the vertical line,

(Continued on page 232)

ON ITS WAY!

YOUR NEW ZENITH RADIO...



**With Exciting New Radionic* Marvels
War-Proved in the Stratosphere . . .**

Soon Coming to Your Home!

FROM WAR-TORN SKIES of numbing cold and violent shock—where life and victory often depend on radio communication—have come great new advances in the science of RADIONICS.

Naturally, many of these RADIONIC MARVELS have reached a new high of perfection at Zenith. For Zenith—without fanfare—has been quietly doing its job as a LEADING PRODUCER FOR OUR ARMED FORCES of Radionic Products Exclusively.

Soon you will enjoy some of these amazing Radionic features *right in your own home*. Zenith engineering genius will bring them to you in a thrilling new line of RADIOS and RADIO-PHONOGRAPHS.

From portables to consoles . . . from standard wave, to short wave, to Frequency Modulation . . . they will set a new standard of performance and beauty.

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JUNE, 1945

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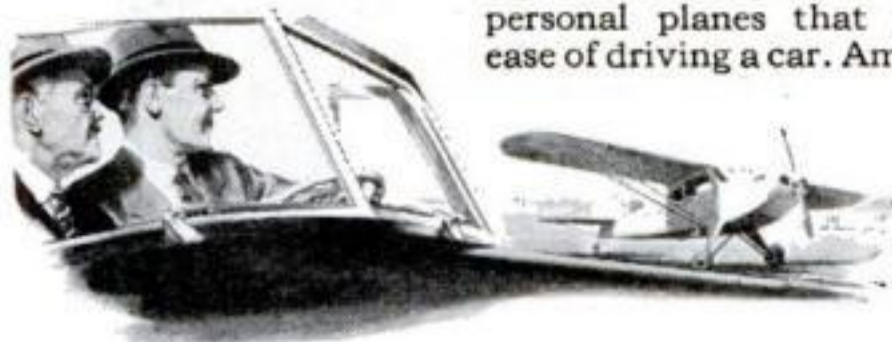
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I know Aeronca is 100% on war contracts now for Uncle Sam. What they're making is a military secret—but there's no hush-hush about the plans they're making for civilians—and plenty!

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Distributors also of Sportsman Pipe Mixture, Sasieni
Fine English Pipes and Sportsman Toiletries for Men.

The Norden Bombsight

(Continued from page 228)

then uses another knob to bring it under the horizontal line.

If his job were merely to hold those hair-lines on the image by the movement of his hands, his work would be comparable to aiming a rifle from a window of the plane. But he must do more than that. He must turn the "course" knob with his left hand, and the "range" knob with his right hand, until the hairlines remain centered on the target's image even though he takes both hands off the controls.

There are two parts to each of these knobs. One part makes temporary alterations in the way the sight is aimed. The other synchronizes the motion of the wheels within the bombsight with the motion of the airplane so as to retain as much of those alterations as is necessary to create the illusion. Hence, the bombardier must use his fingers as skillfully as though he were playing a violin.

Nero fiddled while Rome burned. But could he have found the right notes, while preparing to ignite a city, in the midst of flak and running gun battles in the sky? That is comparable to what American bombardiers learn to do.

The new A-6 Bomber Trainer is an important development because it helps our bombardiers acquire this knack quickly, cheaply, and safely. Flying at any altitude from 2,000 to 18,000 feet, and at any speed from 125 to 300 miles an hour, can be simulated with this trainer. The aerial photographs used as targets may be those of real enemy arsenals slated for destruction. The bombardier-to-be sits alone, in a darkened, vibrating compartment, and adjusts the Norden sight just as though he were on a real bombing mission.

The cost of training bombardiers in the air has been estimated at \$150 an hour; the cost of using this trainer is trifling. Yet it enables bombardiers to participate in realistic dress rehearsals before the big show. That's why the AAF already have 350 of these new trainers in use, both in this country and overseas. The men playing with these \$2,800 super-pinball machines are acquiring the skill needed to set bigger fires in the heart of Japan with their Norden wizards.

The Nazis are kaput, but we still have a job to do in the Pacific. Get in on the knockout by supporting the mighty Seventh War Loan! Every bond you buy is a blow at Tokyo!

Have you ever seen a
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Neither have we—but if we *did* see one, we might *pay handsomely* for it, because we are looking for unusual ideas and designs in toys. In fact,

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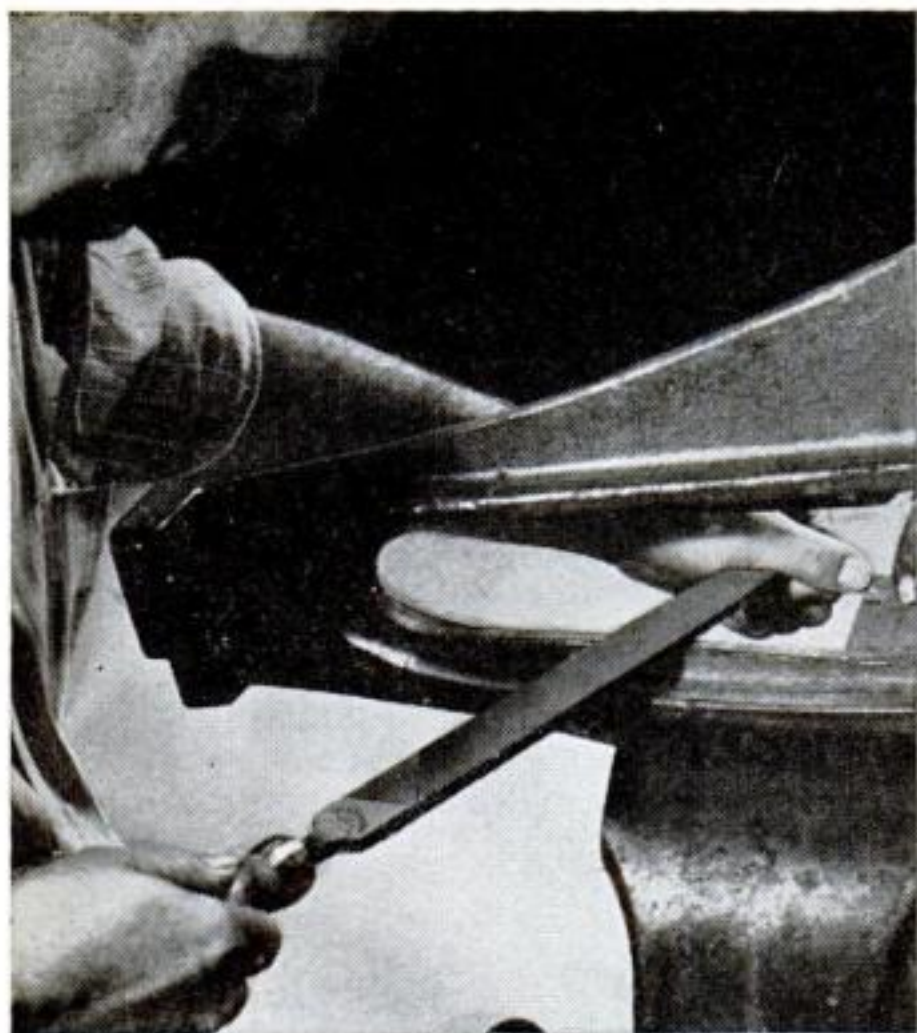
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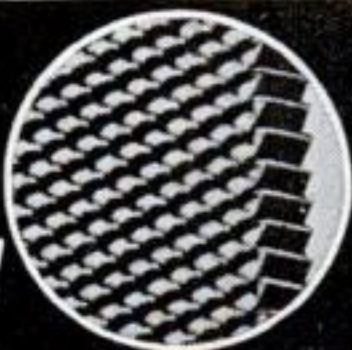
In two pocket sizes: 1 oz. at 20¢ and 1 1/4 oz. at 35¢, as well as two glass humidors: 8 oz. at \$1.50 and 16 oz. at \$2.85. Only at Better Stores.



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- Speed Wash brushes

MILWAUKEE DUSTLESS BRUSH COMPANY

528 N. 22nd Street • Milwaukee 3, Wisconsin

Healing Scars of Battle

(Continued from page 92)

of surface on those portions of the body.

It is possible that arm and leg wounds will run slightly higher than usual in World War II. That is because of the enemy's extravagant use of land mines. The extremities, and especially the legs, take the damage. The character of the wounds varies with the character of the fighting. When American troops were going through the Normandy hedgerows, for instance, head wounds ran high. Heads stuck through the hedgerows got hit. But the figures for the war as a whole average out.

War wounds differ from the injuries suffered in industry and in the home. Bombs, phosphorus projectiles, booby traps, land mines, and air and water blast produce wounds that do a great deal of damage not visible on the surface. The break in the skin made by a bullet may be small. Inside, it shatters bones, severs nerves, and rips tissue apart.

To Col. Howard A. Rusk, chief of the convalescent training division, Office of the Air Surgeon, Washington, D. C., goes the credit for devising a system of body and mind mending which was so successful in the Army Air Forces that it was adopted by the Army ground forces and the Navy.

Applying his thinking to peacetime America, Colonel Rusk sees the day when the useful lifetimes of men who have had hearts or maimed limbs will be extended to the time that they die natural deaths. They will continue to be productive members of their communities.

War's rehabilitation engineering may well become the social engineering of the future.
—DEVON FRANCIS.

Science Makes Rosier Apples

THE fact that the redder apples are, the quicker they are bought, led two Cornell University faculty members to study means of stepping up the color. They worked on the principle that, since healthy dark-green leaves point toward a lively red in apple skins, the results they were looking for would come from proper adjustment in the amount of nitrogen fertilizer fed to the trees. From their data they had a chart prepared to show seven leaf-green shades. The apple grower holds this beside sample leaves to get an idea of how his trees stand with regard to nitrogen nutrition. Research thus far has been confined to the McIntosh, New York State's most popular variety.



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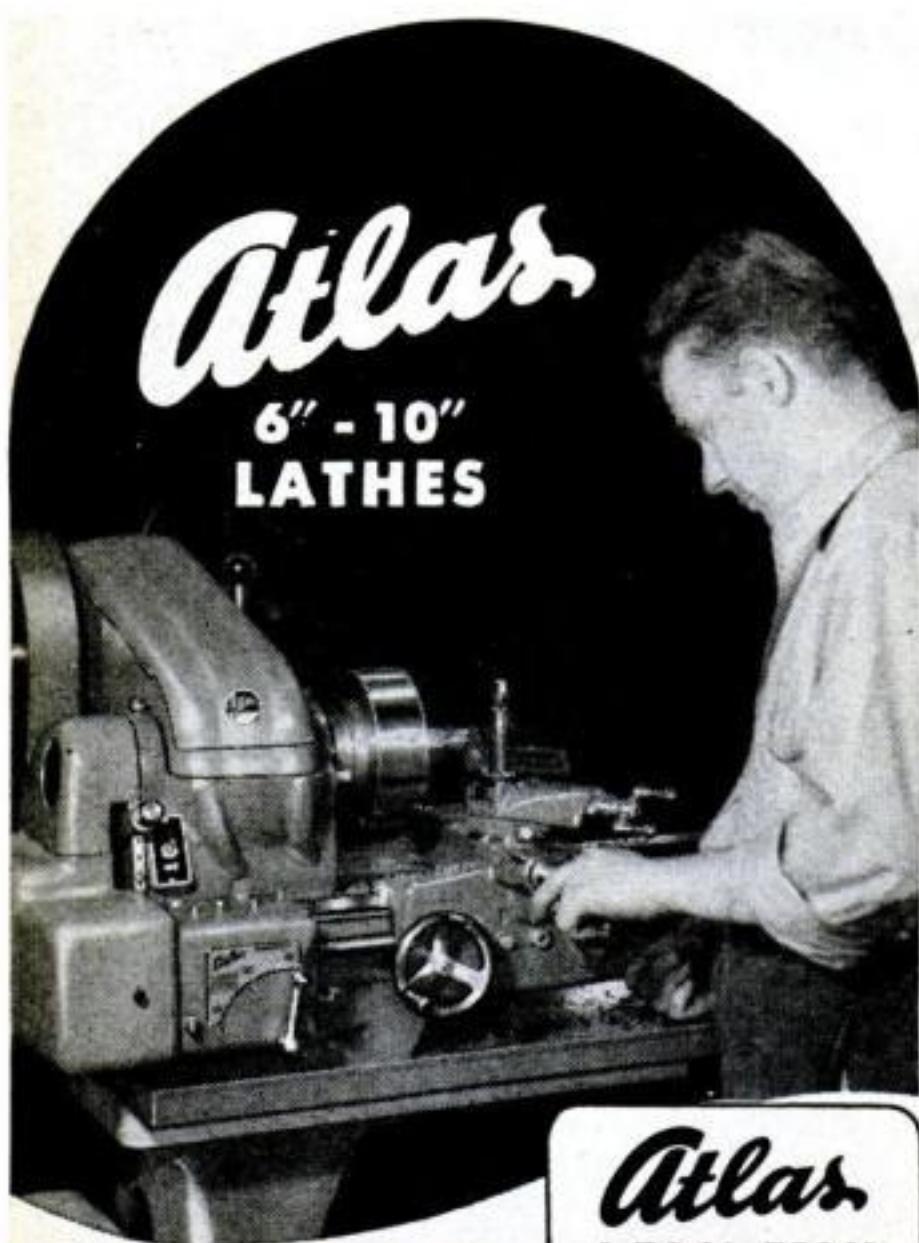


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You'll find everything you want in precision-made and precision-operating tools — thoroughly proved by an amazing war production record. And every modern feature is included to give you the flexibility and long wearing qualities you want at low cost.

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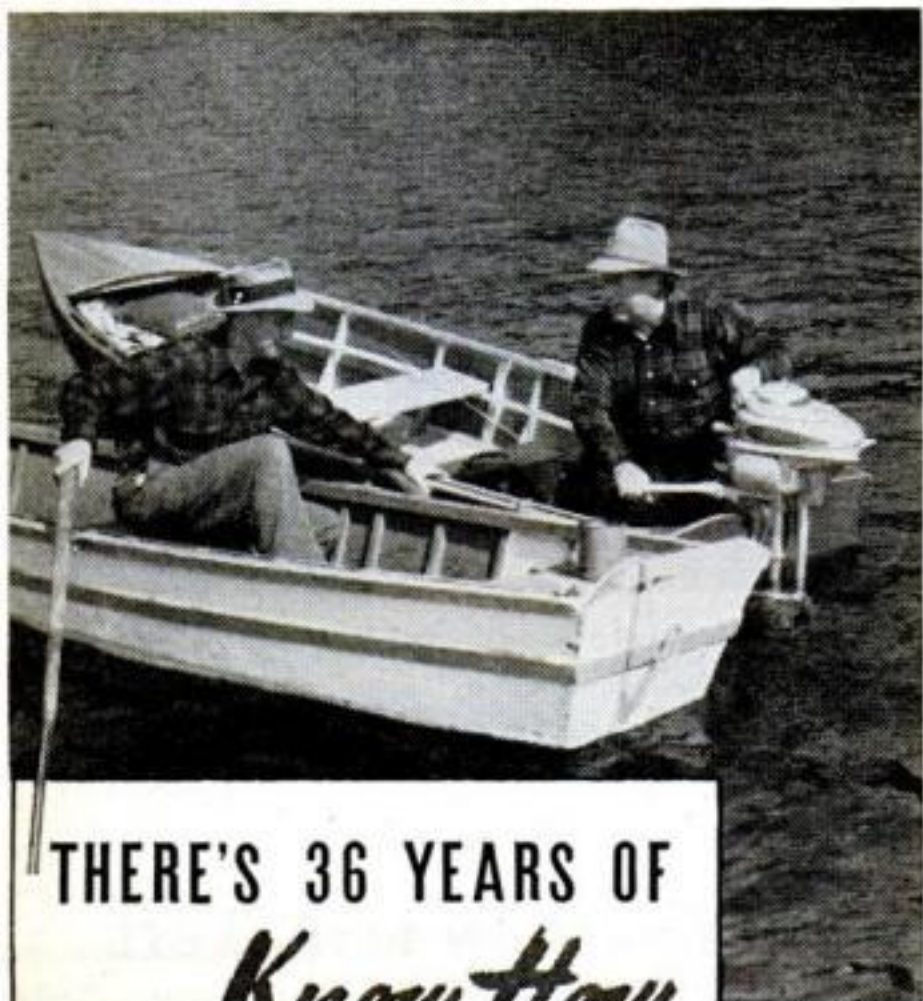
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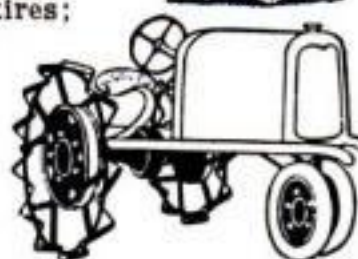
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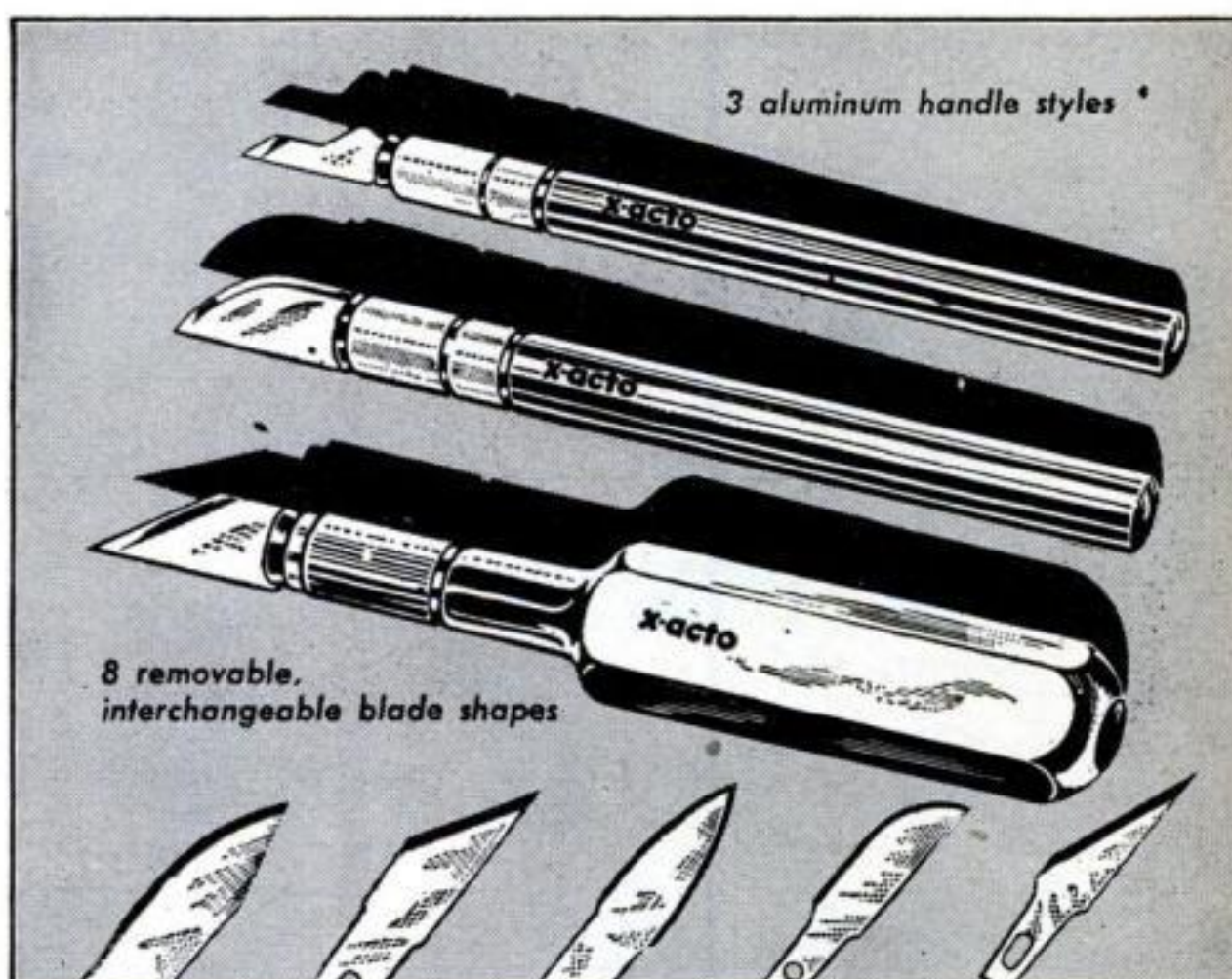
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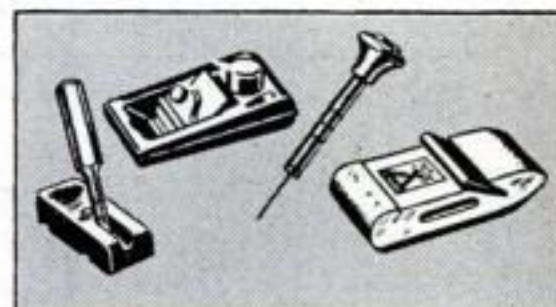


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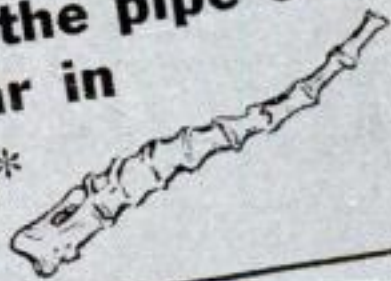
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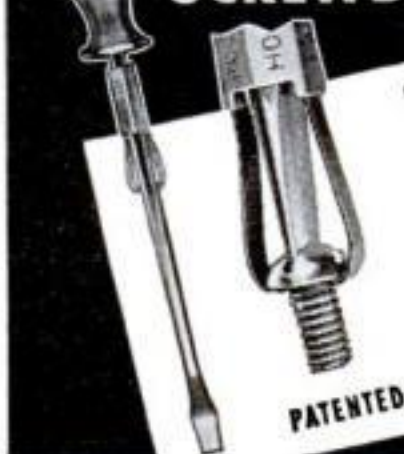
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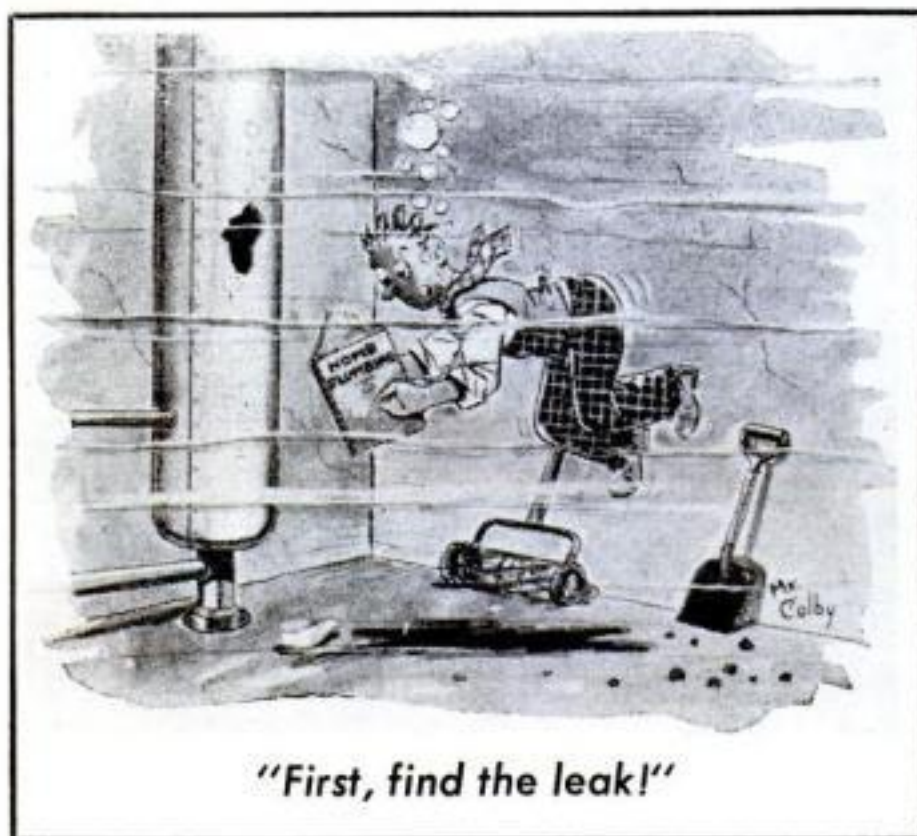
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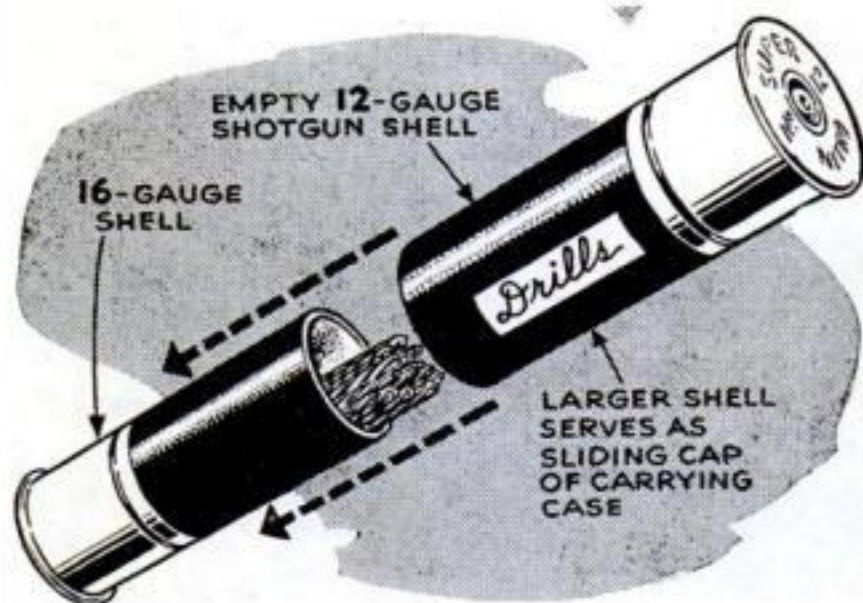
The Quick
ZECOL
Way



NYLON BRISTLES are now being used extensively in sweeping and agitator brushes in drill seeders manufactured by The American Fork and Hoe Company, of Fort Madison, Iowa. The brushes, 2 3/4" in diameter set on an iron-casting center, are available in eight different seeder models and also as a replacement part.

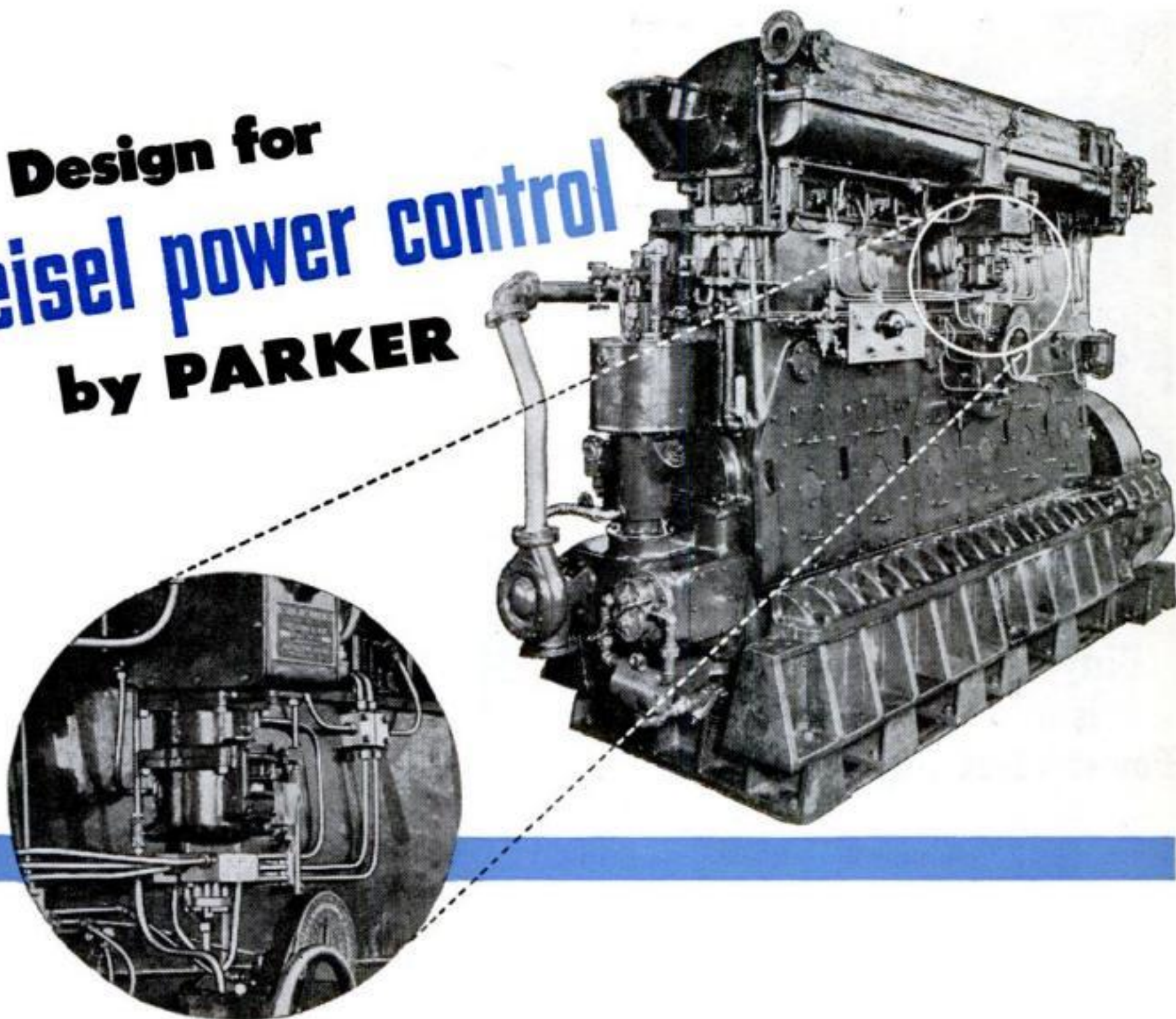
Shotgun Shells Form Drill Case

MACHINISTS and others who carry twist drills and small lathe tools in their pockets or tool boxes will find that a handy drill case may be made by sliding two empty shotgun shells together. They will form a sturdy case, and will help prevent the dulling or breaking of drills. Use one 16-gauge and one 12-gauge shell.—FRANCIS L. TYLER.



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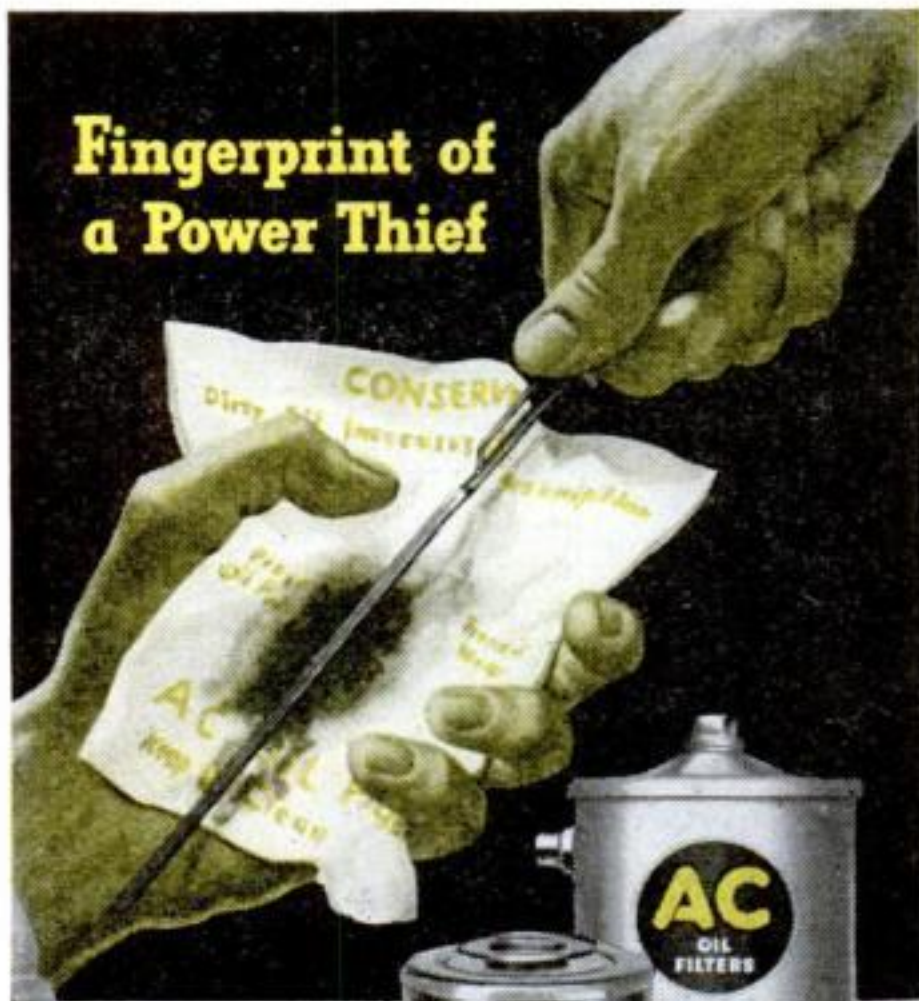
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BOWL GUARD
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bars tobacco fragments
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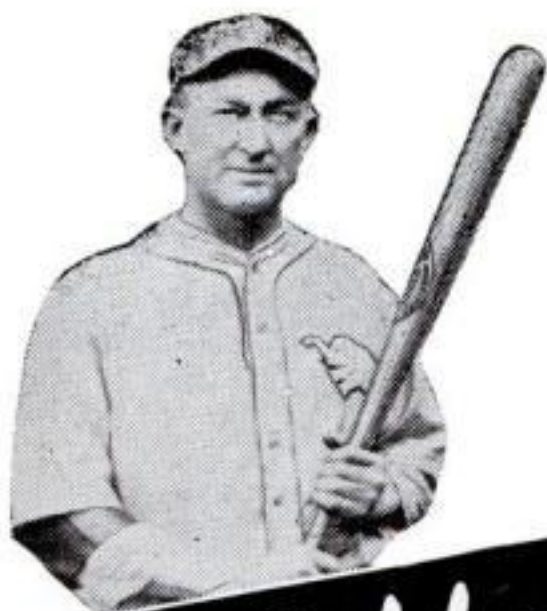
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One of Nature's Rarest Varieties of Wood,
Found in California, Produces these
Sweet-Smoking **MONTEREY PIPES**



Giant Mission Briar Burls

MONTEREY
Specimen Grain
\$5

(also Select
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MISSION BRIAR

**GIANT GROWTHS THAT GROW JUST
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Word came to us of "millions" of acres of Heath shrubs, producing a knob known as a burl, from which sturdy, cool-smoking pipes could be made. After exploring California's Chaparral-covered mountains, we found millions of shrubs, but only a small percentage of burls. The grain is interwoven in texture—yields a cool, sweet-smoking quality not found in ordinary pipes. Look for **MONTEREY PIPES**, made of **MISSION BRIAR**, at your dealer's—Select Grain, \$3.50; Specimen Grain, \$5.



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Kaufmann Bros. & Bondy, Inc., 630 Fifth Ave., N. Y. 20, N. Y.



On the "tough-nuts"
Watch a Snap-on
 — **Go to Work!**

In the sleekly streamlined structure of a modern plane, *tough nuts* are plentiful. Blocked, hidden, fox-holed in sharply restricted spaces, they defy ordinary wrenches to "reach in and do a job".

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Because they handle every nut turning job faster, easier and better, Snap-on wrenches have won the same outstanding preference in the aviation field that they long have held throughout the automotive industry. Everywhere they are "the choice of better mechanics". Write today for the 1945 Snap-on catalog.

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Adds a gleam, sparkle and beauty to floors. No more waxing and polishing. Gives hard glossy durable finish to linoleum, rubber, concrete, tile, cork, wood, all surfaces. Non-skid. Resists alcohol, boiling water, cigarette burns, even lye. Apply it yourself. Quart does average kitchen. 12 colors and clear. Per gallon. **\$6⁷⁵**

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A high speed, one-man driller equipped with fast new type auger. For any row crop tractor. Easy to operate from driver's seat. Make big money doing custom digging. Guaranteed. Write for details. OTTAWA MFG. CO., 601 Elm St., Ottawa, Kans.



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"3-IN-ONE" OIL



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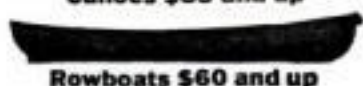
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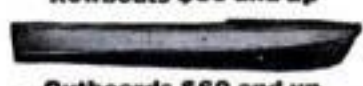
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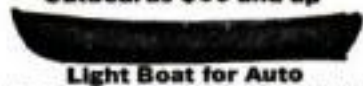
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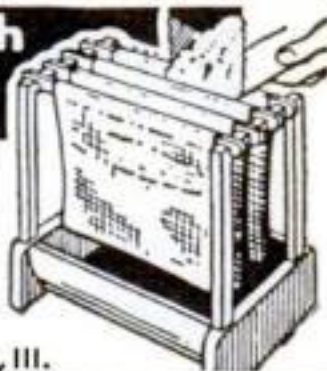
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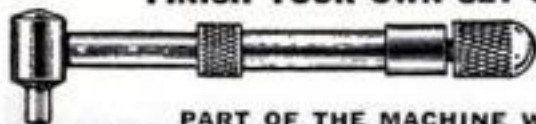
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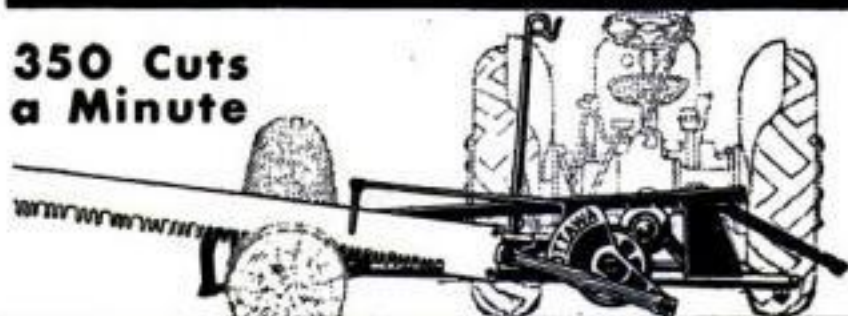
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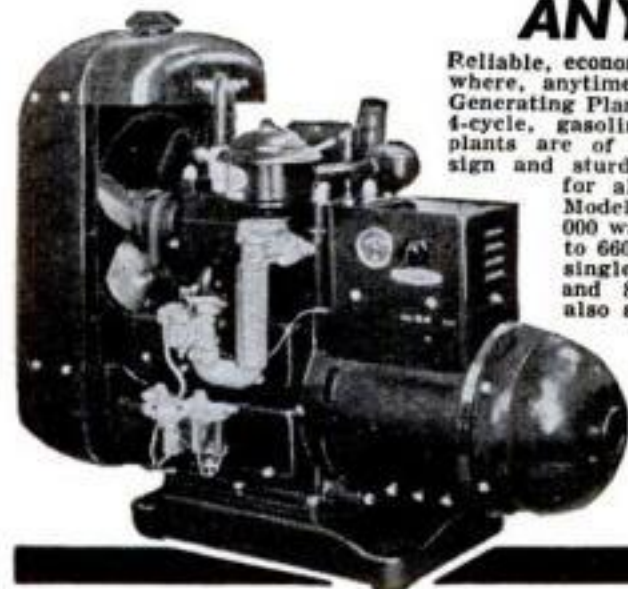
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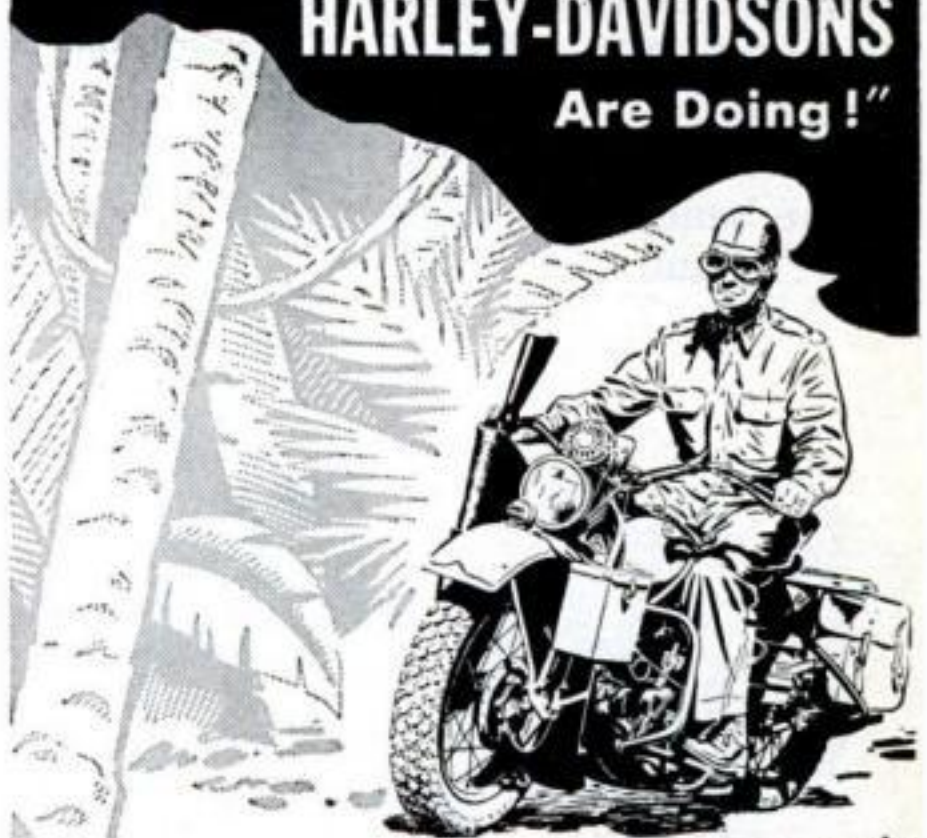
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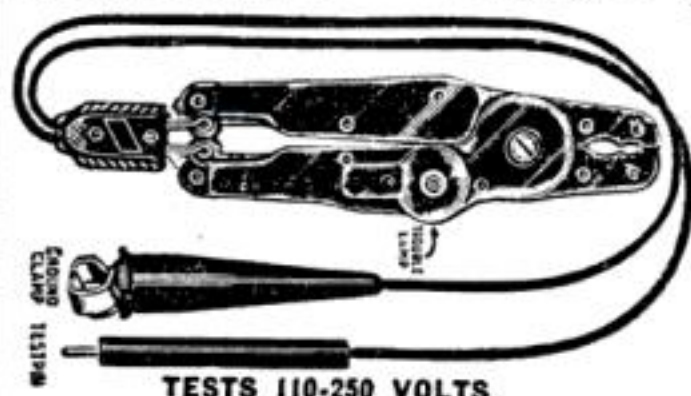
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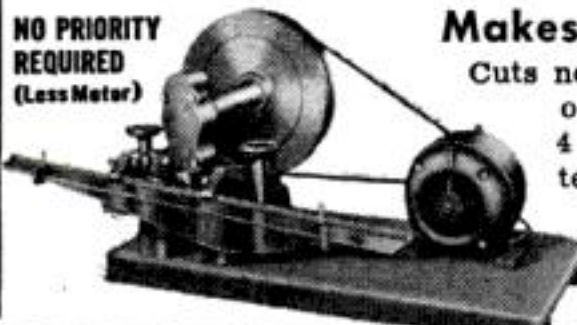
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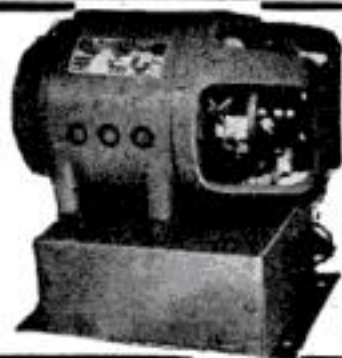
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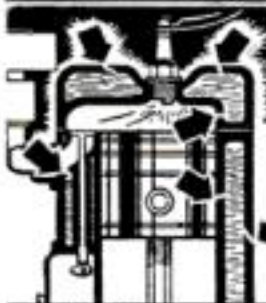
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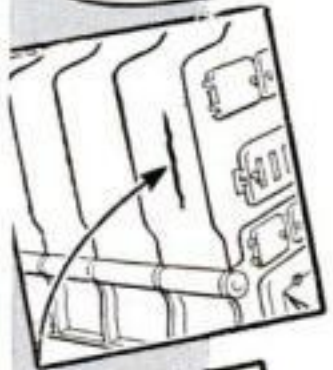
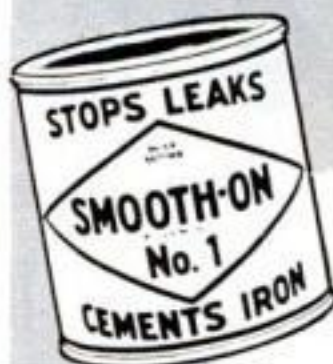
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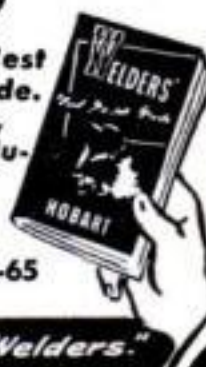
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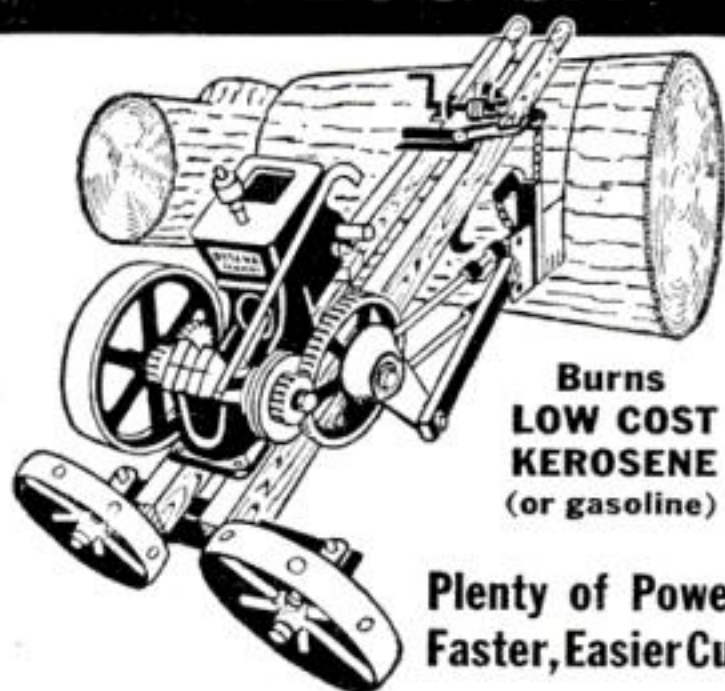
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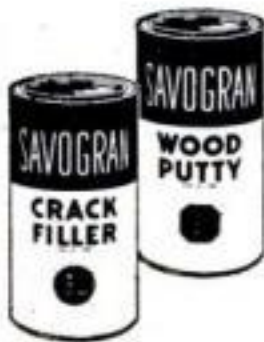
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Why is he silly?

Because every time you pay more than ceiling prices, every time you buy rationed goods without stamps, you are breaking down the very controls that have kept your cost of living lower in this war than in World War I.

What else can you do to keep prices down? Tuck away every dollar you can get your hands on. Put it safely away into War Bonds, life insurance, savings banks.

Why? With more money in people's pockets than goods to spend it on—every unnecessary thing you buy tends to push prices up.

Save. Don't spend. It's common sense for today—safety for tomorrow.

A United States War message prepared by the War Advertising Council; approved by the Office of War Information; and contributed by this magazine in cooperation with the Magazine Publishers of America.

ONE PERSON CAN START IT!

You give inflation a boost . . .

—when you buy anything you can do without

—when you buy above ceiling or without giving up stamps (Black Market)

—when you ask more money for your services or the goods you sell.

SAVE YOUR MONEY. Buy and hold all the War Bonds you can afford —to pay for the war and protect your own future. Keep up your insurance.

**HELP
US
KEEP**

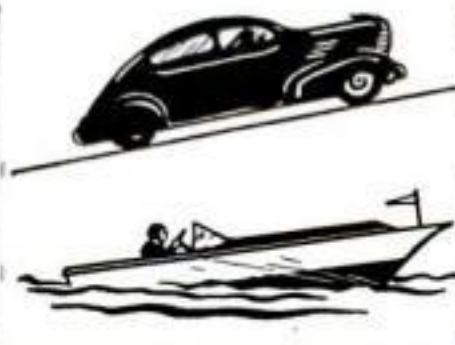
PRICES DOWN

Drive A CAR

BOAT, etc., THAT

RUNS ON LIQUID AND AIR

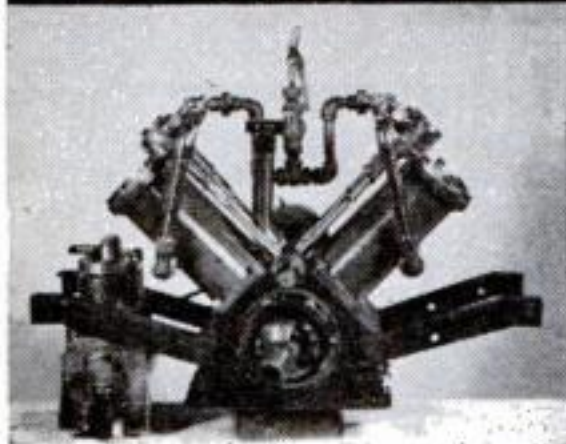
LOWER COST OF OPERATION ON UNRATED FUEL



THE PERRYMOBILE

Operates with a two-unit power plant embodying only a motor and heater.

NO Spark Plugs — Clutch — Gearshift
Transmission — Carburetor — Fan
Distributor — Self-Starter — Fly-
Wheel; No Gas, Dangerous Fumes
or Noise.



BUILD THE POWER PLANT YOURSELF or have it built
From Easily Understood Blueprints and Specifications.

An amazing new power plant you can build yourself or have built. Operates on vapor and air pressure. Motor weighs only 165 lbs. Fits most chassis or boat. Buy or build your own parts. Hundreds of Perry Motor enthusiasts are now doing it.

FULL POWER AT ANY SPEED

Operated by vapor and air pressure. Uses kerosene, stove oil, distillate or any low grade fuel for heater. Delivers full power at any speed — from a cold start in a few seconds.

MOTOR CANNOT OVERHEAT

No fire or explosions in the Perry Motor. No carbon forms. No valves to grind. Motor cannot overheat and requires no cooling. Great saving in fuel.

THE CAR OF THE FUTURE, TODAY!

The PERRY MOTOR, pictured, is a 4-cyl. V-type motor, using crankshaft, connecting rods, pistons and valves. Will fit in chassis of virtually any make car up to 3000 lbs. gross weight.

State Franchises Open to Financially Responsible Companies or Persons.

MAIL COUPON TODAY FOR DETAILS

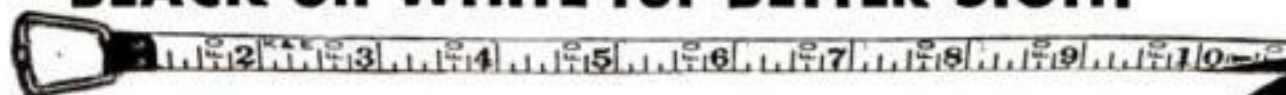
PERRYMOBILE COMPANY, Dept. 6, 663 W. Jefferson Blvd., Los Angeles 7, Calif.
Please send me, without obligation, free literature further explaining the PERRY MOTOR, and cost of blue prints to build one motor for my own use.

NAME.....

ADDRESS.....

CITY.....STATE.....

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WYTEFACE Steel Tapes have black graduations on a crack-proof white surface. Easy to read in any light, from any angle. Faster measurements with fewer errors. Designed for hard service. Resists abrasion from rails, pipe, rocks, concrete. Protected against rust.

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TRADEMARK
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KEUFFEL & ESSER CO.
EST. 1867

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Drafting
Reproduction
Surveying Equipment
and Materials
Slide Rules
Measuring Tapes

SHARPEN YOUR DRILLS WITH THE E-Z DRILL SHARPENER

This precision fixture was developed for factory use by aircraft tool engineers. Real shop size and not a toy. Sturdily built, attaches to bench or grinder frame. Has new **PROTRACTOR FEATURE** which enables you to adjust quickly for different drill angles. Thousands now in use—home and repair shops, garages, factories, farm shops—wherever accurate holes are drilled. E-Z is simple to operate. Gives faster drilling, perfect hole centers and clearance. Guaranteed to do the work or money back.

**SHARPENS ALL ROUND SHANK DRILLS FROM THE SHORTEST
TO 11" LONG—3/32" TO 1 1/16" DIAMETER**

SAVE MONEY WITH E-Z. Comes complete with instructions, ready to sharpen your dull drills as good as new. Low price of \$2.80 because of our volume business on this wanted precision tool. The E-Z protractor gives you proper angles for cutting extra hard material, ordinary use, for soft material, wood, Plexiglas, Lucite, Plastics. Send check or money order for \$2.80. **WE PAY POSTAGE AND SHIP IMMEDIATELY.** Write for FREE folder giving scientific data on drilling techniques.

FRED F. TEN EYCK, Dept. S5, 758 S. Irolo St.
LOS ANGELES 5, CALIF.

MODEL No. 1 is already set for 59° drill angle, no adjustment needed for 99% of drills. Sturdy shop model. Postage paid \$1.98.



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Electric Stoves
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Automatic Electric Irons
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Fixes Scratches, Dents, Nicks



You can easily restore beauty to damaged wood surfaces with this new practical kit. Enables anyone to do fast, easy touch-up jobs like a professional cabinet finisher. Repairs holes, burns, gouges, scuff marks, etc. Complete outfit—pays for itself over and over.

Amazing Results—Easy to Use

Kit includes 23 different items—scratch removers for slight scratches, assorted shades of shellac sticks for deep nicks, bottles of light and dark stains, shading lacquer, alcohol lamp with fuel, stainless steel spatula, touch-up brushes, scratch sticks, steel wool, sandpaper, rubbing liquid. Packed in handy leatherette finish case. Send for it today. Best investment of lifetime. Fully guaranteed. Detailed instructions supplied.

\$3.95

Postpaid

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TELESCOPING MEASURING TOOLS

... Measure All Holes, Slots, Etc.—5/16 Inch to 6 Inches ...
Gives You Outside Micrometer Accuracy on Inside Measurements
FINISH YOUR OWN SET OF FOUR TOOLS



Only **\$2.95 C.O.D.**

Plus Usual Small Postal Charge
PART OF THE MACHINE WORK ALREADY DONE—ONLY
SIMPLE LATHE WORK NECESSARY TO COMPLETE. No special tools
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material (part machined); simple drawings, and detailed instructions.
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plete **\$20**

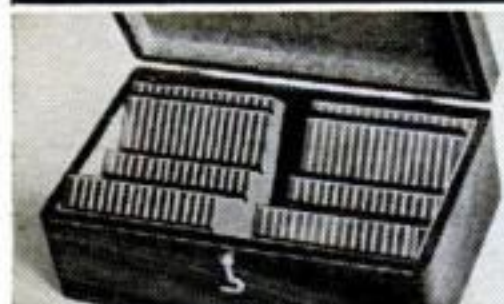


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The G. H. Q. miniature gasoline engine that
really operates is still available. Over 100,000
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and full instructions. Fully bench tested and
ready to run. Power for all models. \$20 com-
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Catalog of hundreds of hobby items.

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Set of toolmak-
ers' matched
angle irons, in
case, \$45.00.
Single toolmak-
ers' angle iron,
\$23.50.
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allels, two
V-blocks, in
case, \$14.50.



SCHERR MAGNE-BLOX transform magnetic chucks into special fixtures

V-blocks, parallels, angle irons, of laminated con-
struction that extends the magnetic gripping power
of the chuck. They eliminate mechanical holding
devices—can be combined in many ways to hold
awkwardly shaped work, round
work, at a true vertical, or at a
vertical angle as set by sine bar.
Magne-Blox save your magnetic
chucks. Where high accuracy de-
mands dressing off the chuck sur-
face, it is far cheaper to use Magne-
Blox parallels and grind them
instead. Various sizes and forms
in stock. For special needs we can supply specially formed Magne-Blox, such
as V-blocks ground at special angles, etc. Let us quote.

Every toolmaker will want one or both of the low cost sets shown at left.
Send check, money order, or we will ship C.O.D. The Scherr 10-day money-back
offer protects you absolutely. Order now.



Part held at true vertical by Magne-Blox
angle iron and two parallels. Work is held
magnetically by the vertical side of the angle
iron, as well as by the horizontal face of the
chuck. The small laminations in the Magne-
Blox transmit magnetic holding power, elim-
inating clamps.

GEO. SCHERR COMPANY, Inc. 200-PS LAFAYETTE STREET
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DURAPOINT DRILLS FOR CONCRETE, STONE GLASS, HARDENED STEEL

Style S (Standard in sizes over 3/8")

Style R (Standard in sizes 3/8" and under)



PRICE LIST

Diameter	Net Price Each	Over-all Length (A)	Diameter (B)	SHANK Length (C)
1/8"	\$ 2.75	3"	7/64"	1 1/2"
	3.00	4 1/2"	7/64"	1 1/2"
3/16	2.75	3"	11/64"	1 1/2"
	3.00	4 1/2"	11/64"	1 1/2"
1/4	2.75	4"	7/32"	1 1/2"
	3.00	6"	7/32"	1 1/2"
5/16	3.00	4"	1/4" or 9/32"	1 1/2"
	3.25	6"	1/4" or 9/32"	1 1/2"
3/8	3.25	5"	1/4" or 5/16"	1 1/2"
	3.50	7"	1/4" or 5/16"	1 1/2"
7/16	3.50	8"	1/4" 5/16 or 3/8"	1 1/2"
	3.75	6"	1/4" 5/16 or 3/8"	1 1/2"
1/2	4.00	6"	1/4" 5/16, 3/8 or 7/16"	1 1/2"
	4.25	8"	1/4" 5/16, 3/8 or 7/16"	1 1/2"
9/16	4.25	6"	3/8" 7/16 or 1/2"	2"
	4.50	8"	3/8" 7/16 or 1/2"	2"
5/8	5.00	6"	3/8" 7/16 or 1/2"	2"
	5.25	8"	3/8" 7/16 or 1/2"	2"
11/16	5.50	6"	7/16, 1/2 or 5/8"	2"
	5.75	8"	7/16, 1/2 or 5/8"	2"
3/4"	6.25	8"	1/2" 5/8 or 11/16"	2"
	6.50	10"	1/2" 5/8 or 11/16"	2"
13/16	7.00	8"	1/2" 5/8 or 3/4"	2"
	7.25	10"	1/2" 5/8 or 3/4"	2"

Diameter	Net Price Each	Over-all Length (A)	Diameter (B)	SHANK Length (C)
7/8"	\$ 7.75	8"	1/2" 5/8, 3/4 or 13/16"	2"
	8.00	10"	1/2" 5/8, 3/4 or 13/16"	2"
15/16	9.00	10"	1/2" 5/8, 3/4 or 13/16"	2"
	9.50	12"	1/2" 5/8, 3/4 or 13/16"	2"
1	11.00	10"	1/2" 5/8, 3/4 or 7/8"	2"
	11.50	12"	1/2" 5/8, 3/4 or 7/8"	2"
1 1/16	12.75	10"	1/2" 5/8, 3/4 or 1"	2"
	13.25	12"	1/2" 5/8, 3/4 or 1"	2"
1 1/8	14.50	10"	1/2" 5/8, 3/4 or 1"	2"
	15.00	12"	1/2" 5/8, 3/4 or 1"	2"
1 3/16	15.25	10"	1/2" 5/8, 3/4 or 1"	2"
	16.00	12"	1/2" 5/8, 3/4 or 1"	2"
1 1/4	16.25	10"	1/2" 5/8, 3/4 or 1"	2"
	17.00	12"	1/2" 5/8, 3/4 or 1"	2"
1 5/16	17.00	10"	1/2" 5/8, 3/4 or 1"	2"
	17.75	12"	1/2" 5/8, 3/4 or 1"	2"
1 3/8	17.75	10"	1/2" 5/8, 3/4 or 1"	2"
	18.50	12"	1/2" 5/8, 3/4 or 1"	2"
1 7/16	18.50	10"	1/2" 5/8, 3/4 or 1"	2"
	19.25	12"	1/2" 5/8, 3/4 or 1"	2"
1 1/2	19.25	10"	1/2" 5/8, 3/4 or 1"	2"
	20.00	12"	1/2" 5/8, 3/4 or 1"	2"

Drills in 64ths and 32nds now in stock, tolerance normally +.005, -.000; tolerance of .001 for 5% extra; tolerance of .001 1/2 on special order. Please do not order closer tolerance than you need. Drills below 1/8" on special order. All drills from 1/8" to 1 1/2" not listed made at the price of the size next larger. Specify your largest chuck size.

Durapoint Glass Cutter, like a pencil, better than a wheel cutter for circular cutting. \$2.50, Postpaid

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LARGE FIRES

SMALL FIRES from becoming LARGE

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Timely fast selling Specialty—easy to carry. Everybody buys our Clear View Idento Case. The perfect Wallet Insert—4 Plastic pockets with two heavy plastic covers. Metal Spiral bound—fits into Wallet, Vest or Blouse pocket and Ladies purse. Sells like "Hot Cakes". Price 50c ea. Cost you \$2.80 Doz. Postpaid. Order trial Dozen today. Do not send personal checks. GUARANTEE Sale of 1st order or money refunded for unsold portion. FREE 3 color display card, sample attached, with 1st order.

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TO SAVE YOU VALUABLE TIME and MONEY!

This portable DYNAMIC WELDER—easily carried right to the job—plugs into any convenient properly wired 110 volt light circuit—works on IRON, STEEL, BRASS, BRONZE, AND OTHER METALS—has 8 metallic and carbon arc welding heat stages—does work you would think only possible with a larger more expensive machine. Once you see a DYNAMIC in operation, you won't want to be without it. Its simplicity will amaze you. In a year the DYNAMIC only costs you about 6c a day. Helmet, rods, cables, holder and operating instructions, etc., furnished.

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You will have no trouble in working out the plans detailed in the LeJay Manual and you will get a lot of enjoyment from them. Whether or not you are mechanically inclined, the projects in these plans will appeal to you for their usefulness and practicability. They will save you money and make money for you, too, in jobs and repairs for neighbors and friends, because the plans embody all kinds of electrical devices.

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For Fish, Meat, Fruit, etc.
From 5° above to 10° below zero.

5 SIZES—8 to 40 Cubic Feet Capacity

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\$18.75
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Checks AC and DC—Volts, Mills, etc.—3" Meter. Guaranteed or your money back. Available now, but stocks won't last long. Write for priority information.

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Slide-rule type. Shows tube characteristics which enable you to substitute available tubes for those hard to get.

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Get this new, colorful payout machine for your recreation room! Soon pays for itself! Three fruit reels. Costs player 5c per play. Pays off one quarter automatically on two cherries etc. (Retains 60% for house; 40% winnings for player). Also can be operated to pay off tokens, 25c size, bearing odds from 3 to 1 up to 100 to 1. Complete with 121 metal tokens. Size 10 x 10 x 10 in. Metal construction. Wt. 16 lbs. Send \$10.00 deposit, balance C.O.D., F.O.B. Chicago. Immediate delivery.Each, \$49.50



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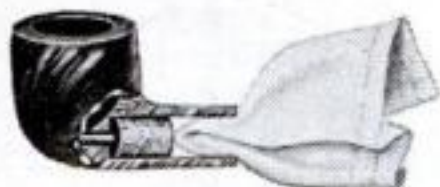
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Simply add **LIQUID PLAST-X**

It's simple—it's easy! Enjoy the superior kind of paint job you want by adding liquid PLAST-X to any oil base paint, and see the difference! You know how much plastic paint jobs cost.

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Use PLAST-X for floors, kitchens, furniture, autos, boats, toys, walls, baseboards and molding, etc.

DEALERS

Write us on letterhead for special discounts on quantities.

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- Helps paint spread smoothly; tends to eliminate brush marks and streaks. Covers more area.
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- Provides a smooth, hard surface that resists scratching, provides longer lasting finish, looks more beautiful.
- Provides extra insulation for clapboard, shingles, stucco, brick, concrete exteriors.
- Reduces dampness and dry rot.
- Economical! Only 4 ounces of PLAST-X mixed with one gallon of paint enough for average room.
- Clean with hose or wet rag like tile; scrub without excessive marring of luster.
- Do not paint as often—save time, money.
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MONEY-BACK GUARANTEE

Order today, enough PLAST-X for all your painting, varnishing, and enameling! If not delighted with results, return unused portion and money will be refunded instantly.

**Builders Products, 500 N. Dearborn St.
Dept. 18 Chicago 10, Illinois**

SEND NO. MONEY—RUSH THIS COUPON!

**BUILDERS PRODUCTS, (Plast-X Division) Dept. 18
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Gentlemen: Please rush me _____ Four Ounce Bottles of PLAST-X C. O. D. for the charges indicated below. It is understood that I must be fully satisfied with the results obtained, or you agree to refund my money without question. Ship me the following:

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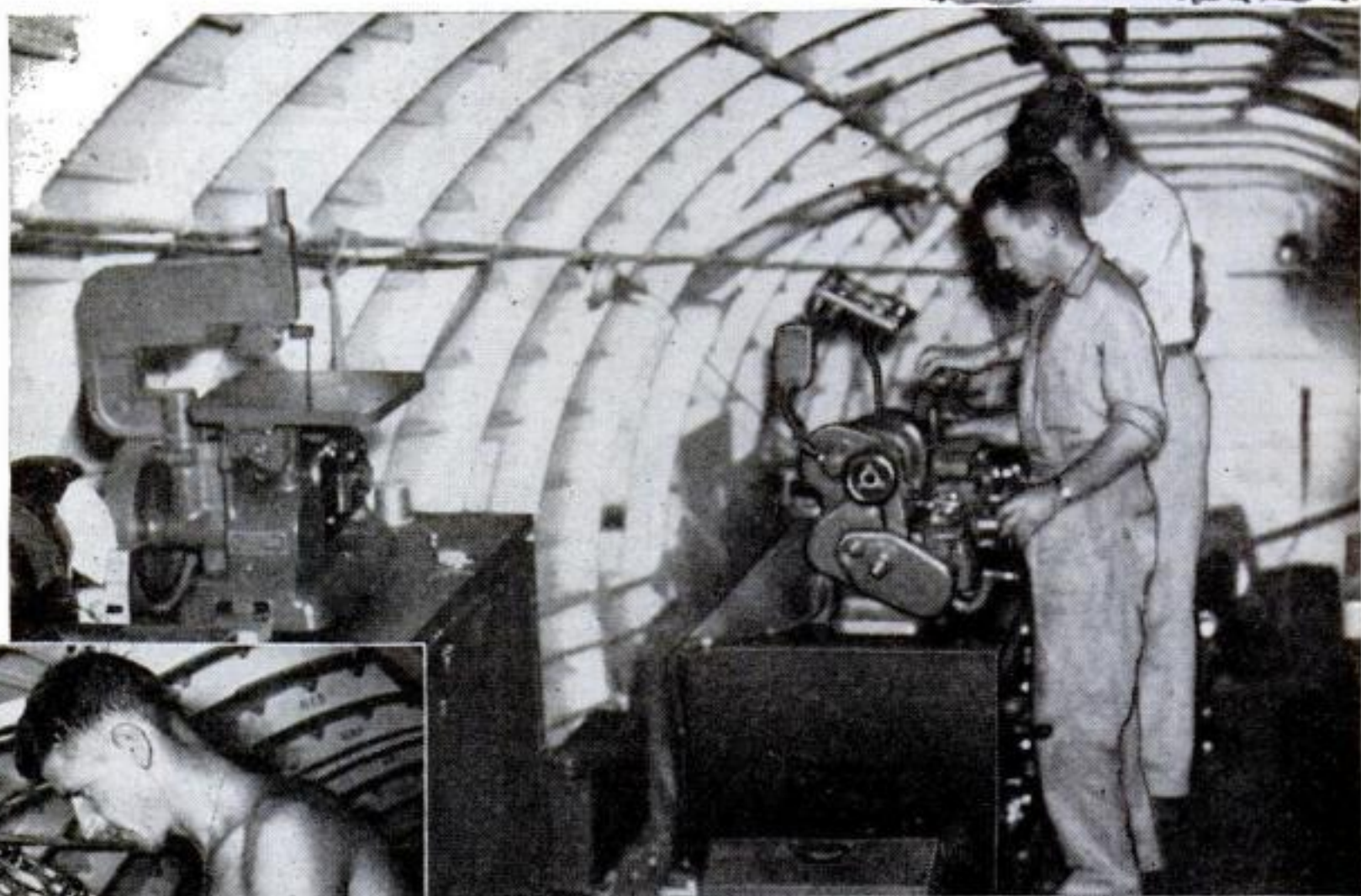
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FLYING MACHINE SHOPS BACK UP THE B-29'S



Interior views of a Commando Flying Machine Shop of the XX Bomber Command equipped with a South Bend Lathe. Official U. S. Army Photos.

Flying machine shops are playing a vital behind-the-scenes role in the operation of the B-29 "Superfortresses" now carrying on the air offensive against Japan.

With ordinary repair facilities, it takes days or even weeks to repair bombers grounded away from their bases—often they have to be abandoned. Now Curtiss Commandos fly machine shop facilities to these planes, enabling them to quickly return to their bombing missions. These flying machine shops, through the diversity of their metal working equipment, are performing every type of repair work except the complete rebuilding of engines and planes.

The unprecedented job being done by these flying machine shops is bolstering our striking power where it is needed the most. As an important part of this equipment, South Bend Lathes are contributing their dependability, accuracy and versatility.



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Shows all South Bend Engine Lathes, Toolroom Lathes, and Precision Turret Lathes in full color. Ask for Catalog 100-D.



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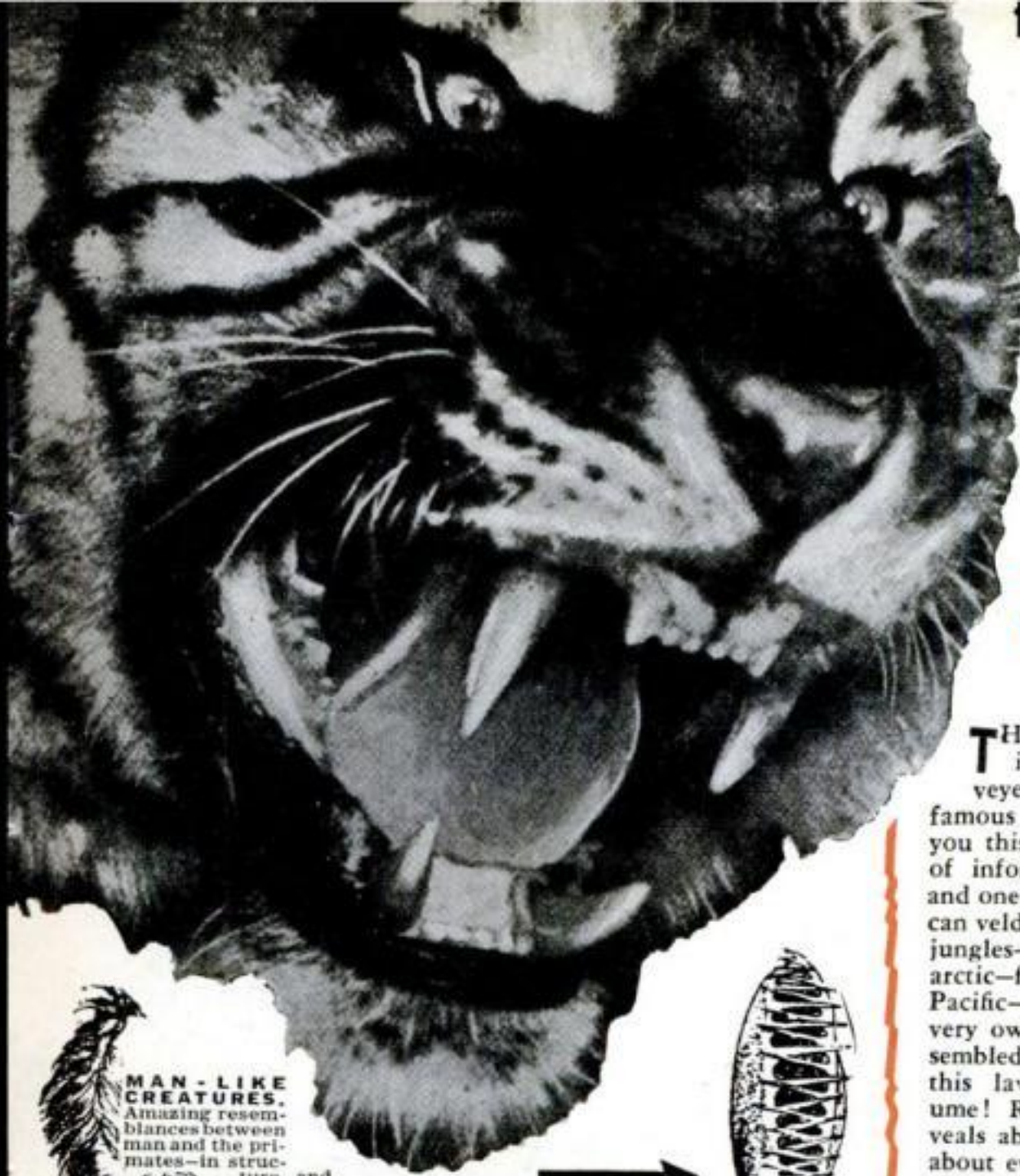
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